ELECTRICAL REVIEW

[ILLUSTRATED]

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The Bunnell Galvanometer and Wheatstone Bridge and Standard Office Measurement Sets.

Many inquiries have arisen concerning this and other forms of galvanometers, and for the benefit of a large number of our readers we illustrate to-day Bunnell & Co.'s standard testing galvanometer and rheostat, and also their office measurement set, comprising another form of galvanometer, rheostat and bridge, which cover, we believe, the principal styles needed by electric light engineers and those engaged in electrical pursuits generally.

The standard galvanometer, shown in Fig. 1, is designed for electrical measurements of instruments, lines, batteries, wires, and any objects of from $\frac{1}{100}$ to 10,000 ohms or more. This galvanometer is sensitive to the highest degree, and is at the same time most substantially and elegantly constructed, with especial reference to convenience in its practical use.

The standard galvanometer is constructed as follows: A delicate magnetic needle is lightly poised on pivots, and carries, at right angles to itself, a light aluminum pointer, extending, on both sides, over a dial having a scale graduated to degrees; the needle is surrounded by three coils of different resistances. The first coil, which is adapted for use in measuring high resistances, or when weak currents are employed, is made of comparatively fine wire, and has a resistance of 70 ohms. The second coil, which may be employed with medium resistances and currents, has a resistance of 30 ohms; and the third consists simply of a metal band, which passes once or twice round the needle.

Each coil may be used separately, or they may be used in series, so as to constitute a continuous coil of 100 ohms.

The instrument is handsomely mounted in a brass case, with glass cover, and is set on a base of vulcanite or hard rubber, which stands on three adjustable leveling screws. It is provided with a damping device, by which the needle is maintained in a stationary position, so as to avoid injury when not in use, or while being carried about; and has also a device by which the movements of the needle are ordinarily limited to variations of a very few degrees. This arrangement, by means of a projecting handle, can be turned round the case, so as to be useful, irrespective of the extent of deflection.

The Wheatstone bridge and rheostat, combined, shown in Fig. 2, is for use with the galvanometer, shown in Fig. 1, and has a capacity of from $\frac{1}{100}$ to 11,000 ohms.

The resistance box, or rheostat, consists of a stout but handsomely-made box of metal, having a mahogany base and a hard rubber cover, on which, in addition to the plugs for controlling the resistances, there are six binding screws or terminals, two of which (one and two) are for the battery wires; two others (three and four) for the attachment of the object to be measured, or, as in the case of a line terminating at the distant end in a ground wire, for the line and home ground wires; while the remaining two (five and six) are usually for the galvanometer wires.

Two circuit-closing keys are also provided, one of which *K* controls the battery, and the other, when depressed, completes the galvanometer circuit.

A lever and cam is fitted to the battery key, by which it may be maintained closed, when a constant battery current is required.

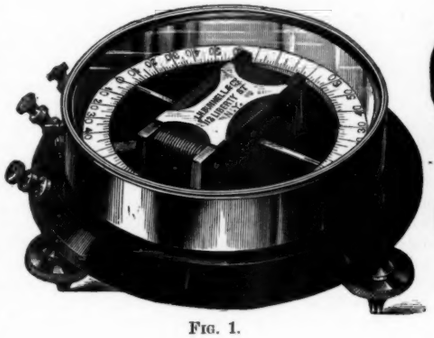

FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

Figs. 3 and 4 show what is commonly termed an office measuring set, consisting of galvanometer, rheostat and bridge.

The rheostat is adjusted to balance all resistances between one-tenth and two thousand ohms. Very comprehensive instructions for using the galvanometer and rheostat, and also many practical hints for use in Wheatstone bridge measurement, together with some valuable formulæ, may be found in Lockwood's "Electrical Measurement," published in 1883, and in this connection would say that this book we learn is furnished as a part of these sets, giving, as it does, very complete instructions for their practical use. It has been aptly said that every telegraph operator, every telephone manager or inspector, and every person engaged in any employment in which electricity is used, should be conversant with simple testing and measurements.

Not only is such knowledge a most useful acquirement, but its practice is interesting and fascinating in the extreme, even if indulged in merely as a pastime. Just as in the cases and circumstances instanced we employ weights and measures, so we may, in the applications of electricity, employ various measurements for many purposes, and we shall find that by basing our practice on these measurements we shall have both better and cheaper results.

As, also, we commonly employ suitable instruments and apparatus in weighing and measuring tangible substances, using scales or balances for those bought and sold by weight, tape measures and rules for measurements, and clocks and watches to mark the advance of time, so we find it essential, in the valuations and comparisons of electricity, to use suitable instruments

These instruments are called galvanometers, and are capable of being used to measure, compare and estimate many of the different properties and magnitudes of electricity. By their aid we may readily ascertain and compare the working, strength and value of electric currents, the resistance which electro-magnets, wires and other conductors offer to the passage of the current, the electro-motive force or initial power and the resistance of batteries; and we are also enabled by their use to localize line troubles and other circuit faults.

On Galvanic Batteries for Medical Purposes.

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The object of the following pages is not to discuss the value of galvanism as an agent applicable to the cure of disease, but simply to give the reader interested in the development of electrical science a general idea of the rise and progress of *physical* electro-therapeutics. I shall confine myself to a short description of the best apparatus now in use, avoiding all topics bearing directly upon the question of how and when to apply the current. Purely medical matters must, for obvious reasons, be strictly reserved for discussion before a professional audience.

The application of electricity to therapeutical purposes is by no means of recent origin. We read in Pliny that the Roman physicians plunged their patients in baths containing electric fishes (torpedo), whose discharges were supposed to be beneficial for the relief of certain diseases. During the second half of the last century the electric machine was extensively used for curative purposes. In 1746, Muschenbroeck, of Leyden, happened to connect a gun barrel, which he was charging, with the water contained in a tumbler. Holding the latter in one hand he touched the gun barrel with the other, and immediately experienced a shock, which alarmed him considerably. This experiment created a great sensation among physicists, and led to the discovery of the celebrated Leyden jar. The physiological effects of the electric spark — the powerful muscular contractions which it produces — speedily led to its introduction into medical practice. It was thought that an agent which could throw into convulsions limbs that had been motionless for years must prove a panacea in all kinds of paralytic conditions. But enthusiasm, here as elsewhere, soon overshot its mark, and the publication of innumerable and wonderful cures wrought by the mysterious fluid did much to set up a reaction against its therapeutic applications.

It is a remarkable fact that the existence of current or dynamic electricity also owes its discovery to the physiological effects it produces. "One day," says Dr. Radcliffe, whose graphical account I cannot resist the pleasure of transcribing—"One day in the course of this year (1786), while amusing himself with a common electrical machine near a dish on which lay a number of frogs' legs prepared in the way which it is usual to prepare them for purposes of cookery, Galvani, seeing that these limbs jumped whenever he drew a spark from the primary conductor, was led to think that discharges of atmospheric electricity might make themselves known by similar jumpings. Needing a more delicate electroscope than the one he

had, in order to carry out some investigations on atmospheric electricity with which he was then engaged, and wishing to know whether he had found what he needed, he at once took up the dish, with its contents, and went out of doors, his nephew, Camillo Galvani, who was with him at the moment, going with him. The time was a clear and calm evening in September. It did not promise success, for the sky was free from all signs of electrical disturbances. It proved to be propitious in an unexpected direction. The place was a high terrace belonging to the house at Bologna in which Galvani lived—then the Casa Paufili-Colonna, now the Casa Monti, in the Strada S. Gervasio. The house, the terrace, the railings are still to be seen at No. 96 Strada S. Felice, the only change of moment being in the name of the street. Each pair of limbs was suspended by a small (copper) hook from the horizontal bar of the iron railings which fenced in the highest part of the terrace, the hook transfixing the portion of the spine which had not been cut away." * * * *En!* exclaims Galvani, *motus in rana spontani, varii, haud infrequentes!* Lo! movements in those frogs, spontaneous, varied, repeated!

How, from this fortuitous observation, and the controlling experiments made to establish it, arose, on the one hand, the great discovery of animal electricity; on the other the still mightier invention of the electric pile by Volta need not be related here. A host of physicists and physiologists pressed upon the footsteps of the pioneers of the new electrical science, and soon covered the ground opened to them. At the same time a new era began for electro-therapeutics—the galvanic or voltaic battery displaced the friction machine and Leyden jars, which still lingered among the paraphernalia of Æsculapius.

But the cumbersome imperfection and want of constancy of the original elements, and the disappointment experienced by many who expected to find in the current the panacea of their dreams, caused the new therapeutic agent to sink into a comparative oblivion, which became complete when the celebrated French physician, Duchenne, introduced the induction currents into medical practice (1847). "Faradic electricity," as the new modification of the force was called in honor of him to whose genius art and science owe an everlasting debt of gratitude, soon acquired an importance in the diagnosis and treatment of morbid conditions which all our recent advances have enlarged and confirmed. The compactness of the apparatus, and the great physiological energy of the effects obtained from them, has done much to acquire for the induction coil a recognized place in the armentarium of the physician in all parts of the globe.

Galvanism, however, had in the meanwhile entered upon a new phase, thanks to the invention of a constant depolarizing element (Daniell, 1836), and to the various and successive improvements by which it gained in durability, and in other practical aspects. The untiring zeal of Prof. Remak, of Berlin, who, about ten years after Duchenne's first publication brought out his classical "Galvano-Therapie," accumulated a large mass of experimental and clinical facts which imposed themselves upon the attention of the medical world, though not without a sharp struggle with the ruling power of the day. The result of the conflict was still doubtful when Remak died (1869); but then his influence, as it had been hitherto held latent, became liberated, so to speak, and his labors brought forth an abundant harvest. In Germany there appeared a number of eminent men who, by their thorough and conscientious investigations, placed the importance of the galvanic current in our scientific and practical dealings with nervous diseases, beyond every possibility of cavil. At the same time, as the last echoes of personal rivalries and recrimination were dying out, a reconciliation was effected between the claims of the followers of Remak and those of the disciples of Duchenne. Both forms of dynamic electricity were found to fulfill important indications, and to yield important services in the hands of the physician, and consequently both battery and coil became indispensable adjuncts in the hospital and consulting room, for such, at least, who kept abreast with the rapid advances of nervous pathology. Nay, even the long discarded static machine has lately been restored, under the improved form given to it by Holtz and others as a means of rational treatment in certain disorders.

My intention here is not to speak as a physician, but as a physicist, and to give the readers of this journal some idea of the conditions to be fulfilled by a battery intended to send a current through the human body, and present a sketch of the various improvements recently made in the apparatus designed to meet those requirements.

What electromotive force must such a battery possess? The answer to this question will be found only when we know (1) the strength of current which the organism will bear without damage or discomfort, (2) the resistance of that organism to the passage of the current. Let us take first the question of the resistance of the human body. Now, as I have fully shown elsewhere, this question does not allow of any definite answer. The resistance of the body varies within wide limits (500 to 100,000 ohms or more), according to a number of circumstances, the chief of which are, first, the area of the surface offered to the current on its entrance and its exit; second, the thickness and dryness of the skin at those spots. These variations are reduced within comparatively narrow limits in practice, however (though we must be always prepared to find individual divergencies), by the application to the previously soaked skin of electrodes of proper size and construction. With electrodes about eighteen square inches the resistance encountered may be said to average 1,000 to 4,000 ohms. With reference to the strength of the current which may be applied to the body with comfort and safety, and for periods not exceeding fifteen or twenty minutes, experience has shown that they range between ten and twenty milliamperes. Here again we must, of course, assume electrodes of standard size (eighteen inches square), for it is obvious that the effect of the current on the skin must vary with its density; a quantity of electricity easily borne when diffused over a certain area would cause intolerable pain and produce electrolytic eschars if applied to a single point, or a small surface, even for a short time.

We therefore see that a battery capable of developing an electromotive force of sixty volts, and provided with means of graduation, will fairly fulfill the conditions above mentioned. It is obvious, also, that in presence of the large resistance of the body, and the relatively feeble currents required, the size of the component cells may be diminished without detriment; for the increased internal resistance of the battery, and the small quantity of the exciting fluid, and of the depolarizing material they contain, will, within reasonable limits, be no obstacle to the satisfactory working of the battery.

Remak's original apparatus* was exceedingly ponderous and inconvenient. Though consisting of thirty-two cells only, it weighed about two hundred-weight, and had to be conveyed on a chariot. The elements were of the Siemens-Halske type, viz.: a modified Daniell's, in which the liquids are separated by means of a papier-mache diaphragm; the periodical cleanings and rechargings they required entailed a considerable amount of labor, and were additional obstacles to the popularization of the galvanic current as a means of cure. About twenty years ago, Stöhrer, of Dresden, made the first medical battery on the pattern which long held the first place among apparatus of the kind. It consisted of an oblong case, with a movable bottom on which rested a double row of glass cells half filled with dilute sulphuric acid. By means of a simple arrangement the cells could be lifted so as to receive each a pair of zinc and carbon plates which were suspended from a longitudinal bar, thus throwing the battery into action. It was found that the rough surface of the comparatively large and porous carbons secured a sufficient check to polarization, and that the addition of bichromate of potash or bisulphate of mercury was unnecessary, owing to the comparatively feeble currents required.

In this country medical batteries on the Smee principle (zinc and platinized silver) have once had a certain vogue; they were much more compact than Stöhrer's apparatus, but their initial cost was high. Moreover, the use of acids in all batteries intended to be portable has always proved a serious drawback, and restricted their use in medical practice owing to the accidental spillings of corrosive fluid which, with the most sedulous care, cannot be absolutely avoided.

In France the well-known electrician, M. Gaiffe, has for many years held a distinguished place for the improvements he has effected in medical batteries. He introduced an ingenious chloride of silver element, consisting of a plate of zinc and a plate of cast chloride of silver containing a silver rod, the exciting fluid being a solution of chloride of zinc. The electrodes, with an intervening pad of bibulous paper soaked in the solution, are bound together with a couple of India rubber bands, and contained in a cylindrical vulcanite box. No other liquid is required beyond what is held by the pad, so that the element is practically a "dry" one. Nothing can be neater and lighter than the Gaiffe cell; it would be the perfection of a medical element did it remain unaltered when not in use. Unfortunately this is not the case; the zincs get incrusted with oxides, which, after a while, put a stop to any further electrical action.

The Leclanche element, and its various modifications, have of late years been largely applied to medical purposes both in England and in France. The cells are made of glass, or of vulcanite, which is lighter, and less exposed to breakages. They measure about one and one-half inch in breadth and depth, and four inches in height. The manganese is either loose or pressed into small conglomerate plates. When thoroughly well made such cells fulfill very well the requirements of the physician, who works his batteries intermittently, and through high resistances.

I have recently seen a new arrangement by Chardin, of Paris, which is both ingenious and effective, as it unites the advantages of the Leclanche and Stöhrer types of batteries, the former being eminently portable, the latter easily taken to pieces and charged. Cell is formed of cylindrical glass vessels, like a large test tube, half filled with water, into which a quantity of sulphate of mercury is added. Two corks, of a diameter slightly inferior to that of the tube, float in the liquid, the film of air between the two effectually preventing spilling when the battery is tilted. The cells are arranged in rows, in a box, on a movable bottom, which, when lifted, sets the battery in action by bringing the electrodes in contact with the exciting liquid. Those electrodes consist of small pencils of zinc and carbon fixed to the upper part of the box; when the tube is lifted up they press upon the corks, which are forced to the bottom of the tube, displacing the liquid upwards.

A complete medical battery is fitted with an arrangement called a *collector*,* which enables the operator to diminish or increase at will the number of cells in circuit, so as to regulate the strength of the current according to the requirements of each case. Collectors are of various types, the most familiar having the appearance of a dial; wires connect the cells, taken singly or in pairs, to a series of metallic studs numbered and arranged in a circle around a pivot on which revolves a switch. One of the terminals is connected through the first stud (marked 0) with the first cell, the other with the pivot; the free extremity of the switch being then made to rest on the stud corresponding to the required number of cells, the current is thus graduated with ease and rapidity. In order to avoid a break every time the switch is made to pass from one stud to the next, the free extremity of the spring which terminates it is made broad enough to touch one stud before leaving the other. This is a very important matter, for in numerous medical applications (*e.g.* to the face, eyes, ears, etc.,) such shocks as would be produced by sudden makes and breaks are to be carefully avoided, and the current to be brought up to the desired strength, and again reduced to zero by insensible steps.

Another accessory of importance in the medical battery is the *current reverser*, which enables one to alter the polarity of the rheophores and electrodes, and thereby the direction of the current through the body, without disconnecting and reconnecting them each time. The physiological effects of the anode and the kathode are very different, and the discrimination between them is of the utmost importance in the diagnostic uses of the galvanic current. Moreover, the "voltaic alternatives, as those sudden reversals of the direction of the current through the body are called, have recently been shown to be of far greater importance in the treatment of certain disorders than former observers thought. They excite muscles and nerves very powerfully, and it was believed that their use was fraught with danger; but here, as elsewhere, actual observations have shown how preconceived theories, even when most plausible, may be opposed to the data of experience.

A *galvanometer*, or at least a galvanoscope, should form a *sine qua non* adjunct to the battery. I say *should*, because the fact is unforfunately not yet fully recognized, especially in England, both by those who make and those who use medico-electrical instruments. The necessity of current measurements when the human body forms part of the circuit is so evident a fact to any one conversant with the behavior of electricity in such conductors of variable resistance need not be insisted upon here. I proposed, in 1878, the adoption of the milampere (then called milliweber) as a convenient unit to express the strengths of current used in medical applications, a suggestion that has since been embodied in the report of the special committee of the late International Electrical Exhibition in Paris. Medical galvanometers may be now obtained graduated in milamperes, the most perfect instrument of the kind I have seen being one made by Edelmann, of Munich. The magnet, made in the shape of a bell with a double longitudinal slit, is suspended by a short silk thread in a copper tube round which the coils are disposed. It is almost absolutely dead beat, a characteristic of the highest practical utility for the purposes which it is intended to fulfill. By means of shunts the sensibility of the instruments may be made equal to 1, .1, .01. The dial has been subdivided experimentally in such a way that the current is indicated in milli-, centi-, or deciamperes (from one to five in each case) according to the shunting. For all ordinary purposes, however, a much simpler instrument will prove amply sufficient, provided it be constructed so as to indicate currents from one to twenty-five or thirty milamperes.

Finally, our battery will require some further accessories in the shape of "rheophores" to conduct the current to the body, and "electrodes" or contrivances of the requisite size and shape to bring the skin into close apposition with the distal end of the rheophores. The full discussion of these matters would lead me into professional details unsuitable for these pages. Suffice it to say that rheophores are conveniently made of telegraph wire, well insulated with India rubber; and that the electrodes (called so because the human body behaves like an electrolyte in the circuit), when intended for application to the limbs or trunk, consist of good sized plates of soft and pliable metal, enclosed in chamois leather (well wetted, since the dry epidermis, or horny layer of the skin, acts as an insulator), or of metallic disks or knobs, similarly covered, when the current has to be localized upon smaller areas. In all ordi-

* I am speaking here of the "portable" one which he used to give his celebrated demonstrations in the Paris hospitals in 1864. His fixed batteries were much larger and heavier still.

* The reader will find all the apparatus described here illustrated in the work above mentioned. As manufacturing medical electricians in London I may mention the names of Mr. Thistleton, 1 Old Quebec Street, W., and Mr. Schoth, 282 Euston Road, N.W. Of the innumerable makers of galvanic, magnetic, or electropathic chains, bands, brushes, pads, *et hoc genus omne*, the less said the better.

nary medical applications the strength and density of the current, as well as the time of its flow, are so managed as to avoid any destruction of the skin by the electrolytic action. When, however, it becomes our object to produce electrolysis (as in the treatment of tumors, nævi, and the like), needles are inserted into the part, so as to concentrate the chemical action of the current upon a small portion of tissue. This method must not, however, be confounded with "galvano-caustics," where the current is not sent through the body itself, but through a loop of platinum wire, which thereby becomes incandescent, and is used as a cautery. The battery required for this purpose will necessarily be totally different from those just described. The most convenient consist of two or four bichromate of potash cells with very large surfaces.—*London Electrical Review.*

Magnetism and Electricity.

A magnet is either natural or artificial. A natural magnet is a piece of magnetic iron ore or magnetic oxide of iron (Fe_3O_4), also called loadstone, and it occurs in nature. An artificial magnet is one produced by artificial means. Artificial magnets are of two kinds—permanent and temporary. A permanent magnet is a piece of steel that has been magnetized by bringing it in contact with another magnet or piece of loadstone, or by passing a strong current of electricity around it. A temporary magnet is a piece of soft iron which has been made temporarily magnetic by being brought near to a permanent magnet, or by passing a current of electricity through a coil of wire surrounding it. The properties of a magnet are: 1. The power of attracting certain metals—iron, nickel, cobalt, and, to a slight degree, chromium, and a few others. 2. The property of tending to assume a certain position as regards north and south. A magnetic bar or needle, if allowed to hang by its center on a string, or to float free on a piece of wood in water, will assume a position approximating north and south, but not exactly so. 3. The property of polarity—that is to say, a magnet exhibits its peculiar attracting powers chiefly at the extremities. There is a center of attracting power near each end, but not absolutely at the end, and at this point or center the magnetic power is strongest. These two magnetic centers are called the poles of the magnet; the end which points towards the north is called the north pole, and the one pointing toward the south the south pole of the magnet. When two magnets are brought near each other, the north pole of one will attract the south pole of the other, and repel the north pole. So it has been found to be a law with magnets that "like poles repel and unlike poles attract each other."

With regard to the direction the magnetic needle takes when allowed to move freely, it does not point directly north and south, but it assumes a position pointing a little to the east or to the west of north and south, depending upon the locality at which the observation is made. This is because the magnetic poles in different parts of the north do not correspond exactly with the geographical poles, and the difference between them varies with the location at which the observation is made. This is why nautical almanacs are made to tell mariners the amount of variation from the true north and south made by the compass needle in different parts of the world. This deviation of the compass needle from the true north and south is called the "declination" of the needle. The term "declination" is very liable to be confounded with that of "inclination." When a bar of steel is hung by a thread at its center, it assumes an exactly horizontal position; but if this bar of steel is now magnetized, it will assume a direction pointing north and south, but it will no longer hang exactly horizontal except at the equator of the earth.

At all points north of the equator the north pole of the bar will dip downward, and the farther north you get the greater will be the dip, while at all points south of the equator the south pole of the bar will dip downward; and the degree to which the needle dips from the absolutely horizontal direction is called its "inclination." This is because the two magnetic poles of the earth do not correspond to the two geographical poles, but they appear to lie nearer the center of the earth. To overcome this tendency of the magnetic needle to dip at a varying angle according to the distance north or south of the equator, the needle of the mariner's compass is made by uniting two magnetic bars laid parallel, with the north pole of one adjacent to the south pole of the other, so that they lie with their opposite poles end to end. Such a needle is said to be "static." At a point on the surface of the earth corresponding with latitude 70° N. and longitude 96° 43′ W., the north magnetic pole seems to be located, and at this place the dipping needle assumes a vertical direction. The south magnetic pole is apparently located at latitude 75° 5′ S. and longitude 154° E.

The production of magnetism by induction is a curious phenomenon. If a permanent magnet is brought near a handful of iron nails, it will attract them to it, and as soon as a nail becomes attached to the magnet it becomes a magnet itself and attracts another nail, which in turn becomes a magnet and attracts another, and so on, the magnetic power of each new nail attracted becoming constantly less than that of the preceding one. It is not even necessary that the nail should absolutely touch the magnet in order to assume this magnetic power, for it will be transmitted through short spaces from one to the other. This power which a body acquires by being brought near a magnet is called "magnetic induction." An important fact in this connection is that when a coil of iron wire is made to surround a permanent magnet it becomes magnetic itself by induction, and is capable of inducing magnetism in another bar of iron surrounded by it. This principle is made practical use of in the construction of the telephone and magnetic telegraph.

ELECTRICITY.

Electricity may be generated by means of friction, percussion, heat, chemical action, cleavage and by magnets. The effects of electricity in its different forms are manifested as attraction, repulsion, light, heat, violent commotions and chemical decomposition.

To excite electricity, we must always do something, and the first way of producing it, discovered in the earlier ages, was by rubbing amber, and so the term electricity was derived from a Greek word, signifying amber. It was afterward found that certain other substances, when rubbed, assumed electrical properties, and would attract or repel other materials. This electricity, produced by rubbing or friction, is called statical electricity. This can be held for a considerable length of time, and hence it has received the name of stationary or statical electricity. This is the only form of electricity that we can store up and keep for a time. What is known now as the storage battery does not really store up electricity, but only energy, which can be transformed into electricity at will.

We have a totally different kind of electricity, called dynamical electricity, or electricity in motion. This circulates only in a conductor or along a wire, and it cannot be held. It was first discovered by Galvani in experimenting on frogs' legs, and hence it is often called galvanic electricity. It is now ordinarily produced by means of galvanic batteries and dynamo machines. The third form of electricity is called magnetic electricity, or magnetism.

According to the generally accepted theory, there are two so-called electrical fluids, and these two are commingled in equal proportions in all bodies; and hence all the processes for getting electricity must result in pulling these two electrical fluids apart, and in taking a portion of one away from a body. These two fluids are called one positive and the other negative electricity. It is found that when two bodies are electrified with the same kind of electricity, as both with positive, or both with negative, they repel each other; but when the two bodies are charged with opposite kinds of electricity, as one with positive and the other with negative, or when one body is charged with either kind while the other is left in its normal condition, then the two bodies attract each other. Hence we derive the law which states that "bodies charged with like forms of electricity repel, and those with unlike attract." The gold-leaf and pith-ball electroscopes are constructed on this principle.

When a piece of sealing wax is rubbed, it manifests electrical properties for some time; but certain other substances, like metals, for instance, after being rubbed in the same manner, show no electrical properties, and this is because the electricity easily gets away from them. Thus we find that, while certain substances remain electrified for some time, others do not, and hence these bodies are named conducters and non-conductors. But these terms are not absolute, but only comparative. The metals, carbon, gypsum and acids are called good conductors, while amber, glass, sulphur and silk are poor conductors. If we want to insulate electricity and keep it from running off into surrounding objects, we surround the object containing it with a poor conductor. Thus, the glass insulators on telegraph poles prevent the electricity from leaving the wires and running off into the ground; and the non-conducting materials placed around the wires of the Atlantic cable so protect it that a small charge of electricity will carry a message from here to Europe.

Great difficulty is experienced in experimenting with statical electricity, because it so easily gets away. All substances are conductors to a greater or less degree, including the dust in the air and the moisture in the atmosphere. Perfect insulation, and a warm, dry air, are, therefore, favorable conditions for holding statical electricity. The reason it was not used earlier for practical purposes was because it was so difficult to manage. The electricity which is produced on glass by friction is called vitreous or positive, while that produced in the same manner on shellac or sealing wax is called resinous or negative electricity.

All bodies are charged with an equal amount of the two electrical fluids called positive and negative, but when a body is electrified these two fluids are separated so that one remains in excess of the other. There is always a passage of the electrical fluid in two directions along a conductor; but, when the direction of the current is spoken of, it is the direction of the positive current that is always meant. Statical electricity can also be produced by pressure, as when certain crystals are firmly pressed together; by cleavage, as when two layers of mica are split apart; and by the heat as well as by friction. It may also be produced by torsion. It is found that the charge of electricity, if collected in a spherical body, is on the outside, and not within the body; and if it is not a spherical body, the electricity collects chiefly at the part most nearly pointed. —*C. F. Chandler.*

Lighting the Coast.

The establishment of an electric light tower on Hallett's Point, L. I., and the project to construct a similar one on Governor's Island lead to the hope that the new and improved system of coast lighting, which has proved so effective in French and English waters, is, at no distant day, to be adopted here.

The reports of both the French and English naval authorities show that the electric system of lighting the coast, though more expensive than the oil, possesses advantages which amply compensate for the extra outlay. The inadequacy of the present oil light system for lighting the coast has often been commented upon by navigators. Except under the most favorable circumstances, it is rarely of much value to strange mariners; and, at times, when the weather is hazy especially, it serves only to allure them to their destruction, as did the singing of the sirens to the Argonauts.

In a well ordered system of oil lights, the ranges or circles of visibility, estimated at from ten to twenty miles, intersect each other, so that before a ship loses one light she makes another. But this is only in very clear weather. When thick or foggy weather prevails all is uncertainty. Vessels have been known to run ashore almost at the foot of a light tower without seeing the light; while instances are by no means rare where the intensity of a first order light was so weak that masters have demanded what ship it was—mistaking it for a steamer's white light—and almost immediately thereafter run upon the reef on which it stood. A "fixed" oil light will often, when thick weather prevails, be mistaken for a "flash" light owing to an occasional partial lifting of a fog. We had an instance of this only a few weeks since when a steamer ran ashore at Amagansett, L. I. It was, for a time, supposed that the electric light had a shorter range of visibility in thick and foggy weather than the oil light because of its whiteness, but the experiments made on the English and French coasts showed that the contrary was the case, or, rather, that the intensity of the electric light is so much greater than that of the oil lamp that its piercing power is multiplied. During the French inquiry navigators testified that, save when the fog was unusually thick, they could find their way into a harbor at night by the aid of the electric light towers along the coast.

The difference in cost of maintenance of oil and electric coast lights is not so great as would be supposed. The computations made by the French naval authorities show that the annual expense of a first order oil light is about $1,660, while for each electric lighthouse at La Heve, for instance, it is $2,270, and for that at Cape Griz-Nez, $2,680. Comparing the cost of a unit of light for a lighthouse lit by oil with one lit by electricity, we find that the former costs $81 per unit, while the latter costs $22 at Cape Griz-Nez and $19.40 at La Heve.

By this it will be seen that, considering the far greater intensity of the electric light, it costs far less than oil light. For, of course, it would be manifestly absurd to use a weak light on the coast when a more powerful one was to be had. When thousands of lives and millions of property are at stake a few extra thousands of dollars more or less are of no consequence whatever.

The electric light to be placed on the Hallett's Hall tower is, it is said, to have an intensity of 24,000 candles. The tower itself is 246 feet in height.

Such a light, situated on the coast, ought to be seen on a clear night at sea when at least fifty miles distant, looked at with a strong glass from the royal yard.

As it is now vessels have at times to almost run ashore in order to "make" a light, whereas with the electric system there is reason to believe coast lights could be "made" at a safe distance, even in thick weather.

Bismuth in the Magnetic Field.

Dr. Kerr, of Glasgow, has shown that a mirror of steel placed between the poles of an electro-magnet rotates the plane of a beam of polarized light reflected from it when the electro-magnet is excited. The rotation is in the inverse direction to the current which produces magnetization. M. Hurion, a French physicist, has now shown that bismuth has a similar property. By forming a bismuth mirror and placing it under similar conditions to those of Dr. Kerr's experiment, but using the current of a workshop Gramme machine, M. Hurion found that the plane of polarization of a normally reflected ray was turned through an angle of 18 min. Dr. Kerr's experiment repeated (with a steel mirror) gave 22 min. While upon this subject we may add that M. Henri Becquerel has presented to the French Academy of Sciences a detailed method of measuring the absolute intensity of a magetic field by measuring the rotation of the plane of polarized light traversing a body in the field, and also of measuring the absolute strength of an electric current. Lord Rayleigh is, we understand, also engaged in experiments tending to the latter result. Becquerel's plan is to employ a hollow bobbin, or electro-magnet traversed by a current, and having a tube filled with sulphide of carbon, through which the ray of light passes.

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We invite correspondence from Electricians, Inventors and the Telegraph and Telephone fraternity on matters pertaining to electrical and scientific subjects, and all facts of special interest in connection therewith.

We extend to manufacturers of electrical apparatus an invitation to send to this office any and all facts concerning their business which will be of interest to the public. We make no charge for publishing news.

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NEW YORK, JULY 19, 1884.

CONTENTS.

	PAGE
Standard Galvanometers	1
On Galvanic Batteries for Medical Purposes	1
Magnetism and Electricity	3
Lighting the Coast	3
Bismuth in the Magnetic Feld	3
Editorial Notes	4
The Telephone's One Competitor	4
An Electric Light Battery	5
On a New Dynamo-Electric Machine	5
Telephonic News	6
The New Telephone Bill in France	6
The Bandot Telegraph System	6
Proposed Telegraph Consolidation	6
Atlantic Cable Competition	7
Telegraph in Albany	7
The Telegraph	7
Electrical and Scientific	8
Causes of Disturbance in Telephonic Communications	8
Limit of Telephonic Development	9
Electrical Light News	9
New Electrical Patents	10

The building of a copper telephone line between this city and Philadelphia has been determined upon by the Bell Telephone Company. No. 14 wire will be used, and tests are now being made to determine what make of wire shall be selected.

We actually heard a certain telegraph company pronounced "slow," "old-fogy," and "no good" on Friday of last week, because a rival company got the first of Cleveland's nomination, one thousand miles away, *four minutes* ahead of it. It is one of the wonders of the age which one finds it difficult to realize that within five minutes of the time that the nomination was an assured fact, it was known to hundreds of thousands of people in every considerable city in this country from the Atlantic to the Pacific. It seems as though the limit of speed had been reached.

We hear, from several sources, of people who desire to become subscribers to the telephone, and want to use it, but hesitate about ordering it because of the pending Drawbaugh suit. Such people should be informed that the suit is against the Drawbaugh Company, and that even if the Bell Company loses it, that fact gives the Drawbaugh Company no claim against it or its subscribers. What the result of the present suit may be no one can say with certainty, but it is very clear that no subscriber need give himself any anxiety about it whatever.

"As showing the advantage of the telephone in cases of fire," says the *London Electrical Review*, "it may be mentioned that the news of the recent outbreak at the Theatre Royal Edinburgh, was received by its means at the Central Fire Station within a *few minutes* of the first alarm." And it may likewise be mentioned that, in any American city of reasonable size, every fire-engine house is informed of every fire and of its approximate location within *two seconds* of the first alarm. There is a wide field for the introduction of the fire alarm telegraph in England, if our London namesake is correct in its statements.

The authorities have been carrying on a series of careful experiments at Wimbledon, in England, devoted principally to the solution of two points, namely, the cost of production and the best mode of distributing the incandescent electric light along the streets. Taking as a unit the light of ten candles—or the average effective illumination given by five cubic feet of gas in a street lamp—the cost comes out approximately one half cent per lamp per hour for electric lighting. The most efficient practical mode of distributing light for a main street like that of Wimbledon appears to be a fifty-candle lamp fixed twenty feet high above the center of the road at intervals of 100 feet apart. The *London Building and Engineering Times*, commenting on these experiments, suggests that what ought to follow is a thorough application of the system to some of the London thoroughfares. Our own view is that, until many existing obstacles are overcome, the incandescent light will not prove a success for street use.

We have seen wires in many cities, and have noted their condition carefully, but in no city in the country have we seen so much poor work as in the city of New York. In the matter of electric light wires this is especially notable. They have been put up, in many instances, in a slovenly, haphazard way, with no regard for symmetry, and with little or none for safety. The idea seems to have been to "get there," no matter how, and the "how" has often been remarkable in the extreme. We have always held, and still hold, that an electric light wire, properly put up, is an element of danger to life or limb so small that it is not worth talking about, but we have insisted that the work should, in all cases, be properly done, that reasonable conditions should be insisted upon, and that companies should be held to a strict adhesion to proper rules. When wires cross streets it should be at not less than a certain prescribed height, and extra care should be used in securing them on either side. In this respect the wiring in this city is peculiarly bad. Again, wires should be constantly inspected to see that the insulating covering is intact. Instances are by no means infrequent in New York where the insulating covering, worn away by friction against other wires, hangs in ragged shreds, exposing the bare copper to contact with neighboring wires, and offering an excellent opportunity for accident. Some day a serious accident will result from this slovenly and careless work, and then a great howl will go up against overhead wires, not only in New York, but all over the country. It can easily be prevented by a little reform *now*, and it is eminently desirable that the work should be done.

NEXT WINTER'S BILL.

It is from experience that men learn wisdom, and failure often teaches more than success. The interests that, for one cause and another, are arrayed against overhead wires, worked up a popular howl against the wires, and secured the passage of a law which is as absurd and stupid as the clamor that brought it into being. To call it a piece of defective legislation is to use an exceedingly mild term. It is grotesque in its uselessness, and even those who are most anxious that what it purports to decree should be enforced, see and acknowledge that it is utterly impotent to accomplish anything. Its promoters, men whose knowledge of public affairs is purely theoretical, and who know no more of the art of drawing a bill than so many school boys, see that in reality they have wasted their powder, for they have put forth their efforts and ingenuity in creating a clamor which has, it is true, brought the mountain to labor, but the result has been the bringing forth of a very harmless and ridiculous mouse.

But it must not be supposed that they will rest here. Every criticism of the bill that they have read or heard, every objection that has been pointed out, every flaw which the keen eyes of men learned in the law have detected, every possible defect of every kind, has been noted, all with a view to guidance in framing a substitute bill, to be introduced at the next session of the legislature. Their blunders, dissected and exposed by their opponents, have been to them valuable lessons, which they have laid well to heart, and the result will be seen when the new bill, now being drawn by shrewd and practiced hands—for the dudes and amateurs have been relegated to the rear—is laid before the Assembly next winter. That it will be an impracticable bill is probable, because it will seek to accomplish an impracticable thing in a wholesale way. But it is quite certain that it will be a bill that will "hang together," that its sections will support rather than contradict one another, and that it will at least have the semblance of practicability.

Considering this activity on the part of their opponents, it is eminently desirable that the wire companies should begin *now* to consider what course they will pursue next winter toward preventing unintelligent legislation which would work untold injury to their interests and to the convenience and needs of the public. Last year there was more or less talk by experts before the committee, talk which, we venture to say, the members of the committee neither cared for nor understood. That it was ineffective is very certain, for hardly a vote was given against the passage of the so-called underground bill. Next time a different course must be pursued. It is useless to appeal to legislators from the standpoint of science, for the simple reason that they cannot appreciate it. It is possible that an appeal from the practical standpoint of common sense, joined in by all the wire companies, backed up by written or verbal statements from men whose opinions would count, might have weight. It is possible that investigation and exposure of the animus behind this underground scheme might have its effect. It is possible that an effort to secure the election as members of the Assembly of half a dozen men who have some slight understanding of the merits of this question might not be a bad idea. It is not for us to suggest what is to be done, nor how it is to be done, but we may venture to insist that if anything is to be done it should be done jointly, and that it is by no means too early to begin now.

THE TELEPHONE'S ONE COMPETITOR.

Some of the telephone companies in this country are just now finding it not a little difficult to figure out much of a profit from their exchange business. They find that as the number of subscribers increases, the expenses of operating and of maintenance increase in a proportion more rapid than the increase of receipts; and they find, too, as all business enterprises find, that the expense of doing even the same amount of business grows from year to year. Taking these facts into account, and to many they are brought home in a very serious and practical way, the question arises what is to be done to remedy the difficulty and keep the business on a paying basis.

Of course, it is true that in many exchanges the older and more imperfect forms of apparatus are used, thus involving the employment of more operators than the latest and most perfect appliances have rendered necessary, thereby entailing a constant expense which might be avoided. But even when the very best is used, there are exchanges where it is difficult to make both ends meet and leave any reasonable margin for profit. The very natural inference is that the revenue from each subscriber is not sufficient to defray his share of the operating expense and of the interest on the money invested, and the obvious remedy is to "mark him up."

It would be an interesting thing if one could find out what process of figuring led to the establishment of the rates now charged for the telephone in different places. Competition hardly entered into the calculation, and it is a curious fact worth noting, as upsetting the theories of those who contend that all the ills which this nation suffers grow out of monopolies, that the telephone companies, almost without an exception, set their prices so low at the outset that they were forced to raise them in order to live. A well-known American publisher, being asked how it happened that ten per cent. had been settled upon as the just compensation for an author to receive from the publisher in payment for copyright, replied that it was "the result of a compromise between the cupidity of the author and the liberality of the publisher," and, considering the expense involved in establishing and running a telephone exchange, it seems to us that what the publisher stated as a joke comes very near to being a fact in the matter of the price charged in many places for the use of the telephone. It is true that in the large cities good prices are paid, but it is also true that the service is very extensive, and maintained at great cost. But in the smaller cities it is, to our mind, exceedingly low—lower than is at all necessary. We do not believe that prices should be based on the endurance of the subscriber—in other words, that it should be forced upward until he shows serious signs of revolting and ordering the instrument out; but we do most emphatically believe that prices should be based in a measure on the value of the service rendered. How is that value to be ascertained?

The telephone has one competitor—the Small Boy. Small Boy is, in a degree, capable of carrying a message, and, to a limited extent, of bringing back an answer—*in time*. Small Boy loiters more or less, is generally absent when wanted, requires to have his car fares paid when going beyond the block, exacts an annual vacation, and has a vicious and offensive habit of growing up, accompanied by a demand for an increase of pay. The telephone may not be all that fancy has painted it; but, on the other hand, could fancy paint the Small Boy as he is? True, we were all Small Boys once, but can we conscientiously say that this, in our mature and critical judgment, is an argument in favor of the Small Boy? The Small Boy, in the cities, costs his employer about three dollars a week. Is a telephone, which never whistles in the entry, never loiters by the way, never talks base ball and never grows up—is a telephone, which never speaks until spoken to, never makes a mistake and expects no Christmas present—is a telephone, we ask, as a mere question of comparative usefulness, to be rated below the Small Boy? Certainly, in a large city, a telephone is worth the Small Boy's wages.

We believe that in smaller places the Small Boy, being more numerous, owing to less opportunity for self-destruction, may be had at two dollars per week, or thereabouts. Considering his infirmities and limitations, this is high for the Small Boy, but is it high for the telephone? And is there a place so small, so safe and so healthy that the Small Boy can be hired for one dollar a week? If so, then, in that quiet, secluded nook, away from the world's turmoil, the telephone can, perhaps, be furnished for one dollar per week, or fifty dollars per year; but to expect it below that figure is to raise the Small Boy upon a dangerous pedestal.

It was observed by a gentlemen of color that, if his landlady could not afford to give pudding at dinner for two dollars a week, she had better "sell out to somebody that could." To our mind, people who cannot afford to pay a dollar a week for the telephone should do without it; and we are clearly of the opinion that every telephone that does not yield that amount annually to the exchange with which it is connected is better out than in.

Annistan, Alabama, a town of 6,000 inhabitants, has an electric light plant consisting of one 25-light Brush dynamo, and one 40-light storage battery. The arc lights are used in the streets, and incandescent lights are used in the opera house and in a number of stores. A new hotel, now building, will use 325 incandescent lights.

An Electric Light Battery.

Electric lighting by means of the primary battery would appear to have advanced another step by the introduction of the Lalande battery. This apparatus, however, comes before the public with the remarkable claim that it not only gives a good electric light for nothing, but leaves a profit to the user out of the residual products. The nearest approaches to this have been primary batteries which have given the light at a somewhat low cost owing to the sale value of decomposed elements. The Lalande battery goes far beyond this, and its proprietors certainly, to a large extent, substantiate the claims they set up for it. Practical application on a commercial scale, however, will be the only satisfactory test, and steps are now being taken to apply this test. The battery is composed of a series of cells, each of which consists of an iron tray, in which is placed a layer of the depolarizing agent, which is oxide of copper. Over this, but not in contact with it, is a zinc plate, the tray being filled with a solution of caustic soda. This acts upon and decomposes the zinc only when the circuit is completed, no action taking place when the circuit is open. Upon completing the electrical circuit the oxygen of the oxide of copper combines with the zinc, oxide of zinc being produced and metallic copper remaining behind. When the battery has been exhausted the zinc is recovered from the soda solution in the form of an oxide which is stated to be 25 per cent. more valuable than the metallic zinc. The oxide of copper can be revivified at a trifling cost and used over and over again. We recently inspected the Lalande battery at the offices of Mr. H. A. Fergusson, of No. 31 Lombard street, London. The battery was made up of forty-eight cells each one foot square, and giving a current of between fifteen and twenty amperes, the electro-motive force being a little under one volt. The battery is said to be capable of supplying a current to fifteen glow lamps of ten-candle power each. The current can also be used for supplying motive power. These two points were fully demonstrated, as an excellent and a steady light was produced from nine Woodhouse and Rawson glow lamps, and one of Ayrton and Perry's motors was run at a high speed and developed considerable power. The invention of the battery is due to M. Lalande, but the credit of utilizing it for the manufacture of oxide of zinc belongs to M. J. Berger Spence, the head of the firm of manufacturing chemists bearing his name. Mr. Spence was seeking a means of making the oxide more cheaply than by the ordinary process, and was trying electrical decomposition, when he met with M. Lalande, whose system he has adopted at his works The battery is stated to be perfectly constant so long as the elements remain efficient, and it is claimed that while the light is not being used no waste takes place. There is, moveover, no smell from the battery as when acids are used. On the whole, there appears to be much in favor of the system, and, on behalf of the public, we hope the expectations of the proprietors may be fully realized, inasmuch as they promise to supply the public with the electric light at a price much below that of gas. At the same time they are to make a good profit for themselves out of the oxide of zinc, which is in great request for making paint and for other purposes in connection with the arts and manufactures.—*Times, London.*

The American Association for the Advancement of Science.

A meeting of the Local Committee on the reception of the American Association for the Advancement of science was held in Philadelphia last week, in the Academy of Music, Dr. J. Minis Hays in the chair, Professor A. Carvill Lewis and Dr. Edward J. Nolan, secretaries.

The report of the Treasurer, John Wanamaker, was that the amount of subscriptions at present is $15,305, and he added that the expenses had better be kept within these figures, because the field has been thoroughly canvassed and recanvassed and there is not much probability of obtaining further subscriptions.

It was stated that papers upon scientific subjects will be read by Prof. N. H. Winchell, State Geologist of Minnesota; Prof. W. A. Rodgers, of Cambridge, Mass.; Prof. John E. Sweet, of Syracuse; Mr Broadshear, of Pittsburgh; Prof. M. E. Wadsworth, Cambridge, Mass.; Prof. C. H. Hitchcock, Hanover, N. H; Prof. H. Carvill Lewis, of Philadelphia, and Prof. Alexis A. Julien, of the School of Mines, Columbia College.

It was also stated that Lord Raleigh, the President of the British Association of Science; Sir William Thomson, of England; Prof. Robert Ball, Royal Astronomer of Ireland; Sir John Lubbock and Sir Joseph Hooker will be present at the meeting in September.

The programme of the Local Committee was reported by the Executive Committee as follows: The sessions of the American Association for the Advancement of Science will open at 10 A.M. Thursday, September 4th, in the auditorium of the Academy of Music, when Professor Young will vacate the chair to Professor Leslie, the President-elect. The different sections will also meet on that day. On Thursday evening a lecture will be delivered before the Association, to which the members of the American Institute of Mining Engineers and those of other scientific associations of Europe and America are invited.

On Friday morning and afternoon the general session and meeting of sections will be held as on the previous day. In the evening Prof. C. A. Young will deliver the annual address before the members of the American Association, the British Association, the delegation of the Royal Society of Canada and other societies. After Prof. Young's address a reception will be tendered by the Local Committee.

On Saturday, September 6th, excursions to the coal regions, Water Gap and other places will be offered to the Association and the foreign delegates.

On Monday, September 8th, the General Session and Section will meet as usual. In the evening the Botanical, Microscopical and Biological sections will hold reunions. On the same evening receptions will be given by several private citizens of this city.

Tuesday, September 9th, in addition to the usual session, a reception will take place in the evening in the Academy of Fine Arts, to the members and families of the two Associations and the delegates of the Royal Society of Canada.

September 10th. in the afternoon a lawn party will be held at Haverford College, Special facilities will be offered to those desiring to visit the Electrical Exhibition.

September 11th, in the evening, will be the concluding exercises of the general session. After the conclusion of the meeting a number of excursions will be announced.

The different sections will meet in the following places:

Section A, Mathematics and Astronomy, in Horticultural Hall, room No. 1.

Section B, Physics. Chapel of the Episcopal Academy.

Section C, Chemistry. Chapel and Chemical Lecture Room of Episcopal Academy.

Section D, Mechanical Science. Room No. 2, Horticultural Hall.

Section E, Geology. Main room of Historical Society.

Section F, Biology. Foyer of Horticultural Hall.

Section G, Histology and Microscopy, Hall of the College of Physicians.

Section H, Anthropology. Foyer of the Academy of Music.

Section I, Economic Science. Hall of the Historical Society.

On a New Dynamo-Electric Machine.

By MM. A. Damoiseau and G. Petitpont.

The importance, as far as the yield is concerned, of minimising the quantity of work converted into heat in the wires of dynamo machines is too evident to require enforcing.

As the production of a given magnetic field with an electro-magnet of given dimensions requires always a certain outlay, we cannot think of effecting this reduction on the inductors. The armature alone is open to modifications which enable us to obtain a greater electro-motive force in an equal length of wire traversed by the current.

The arrangement which we have devised for this purpose is the following, and is applicable to the machines of Pacinotti, Gramme, Hefner Alteneck, and Siemens. The expansions of the poles are suppressed, and the poles are approximated to one another so as to affect merely a portion of the ring, the fourth or the eighth. The current is then received at three points of the collector, one in the middle of the part corresponding to the portion of the ring affected, and the two others at either hand of each pole.

Under these conditions, if the inductors are excited by an external source of electricity, and the ring revolves in the direction of the brushes, α, β, γ, if the circuit is open, the difference of the potential between α, β, γ remains the same. But if we close the two circuits with resistances which are equal, and decrease gradually, α, β preponderates, and that in a very decided proportion, nearly one-half. If we render the resistance at $\alpha\,\beta$ smaller the difference is still more striking. But if we diminish the resistance at $\gamma\,\beta$ we perceive, taking account of the loss due to internal resistance, that the proportion of the electromotive forces does not sensibly vary. The intensity of the current circulating between α and β diminishes the electromotive force at $\gamma\,\beta$ without the reciprocal force being sensibly noticeable. The differences of potential between the extreme brushes, though they sometimes attain considerable values (more than 100 volts in a machine now constructed), only generate a current in the inactive part of the ring which may be practically neglected.

We may therefore, for instance, utilize the current $\gamma\,\beta$ to excite the inductors, and we thus obtain a machine which acts approximately as if it was excited in derivation, and which gives, all other things being equal, with an equal linear velocity, and an equal length of wire traversed by the current, an electro-motive force greater by one-third than that which is obtained with the best machines now made.

We have constructed a model in which the ring (of the shape of a disc) has 3,200 kilos. of wire of 1.2 millimeters in diameter, and the electro-magnets 18 kilos. of wire of 1.6 millimeter. The polar surfaces are only 56 square centimeters each, and act upon the ring at its two surfaces. The length of the wire between the two brushes is only 45 meters. With the electro-magnets connected two by two we obtain, at a speed of 690 revolutions, 11.7 amperes, and 64.5 volts at the terminals. At a speed of 1,854 we obtain 207 volts with an open circuit, and at 1,900 revolutions 180 volts at the terminals, and 23.5 amperes with a resistance of 7.5 ohms. The electric yield is, under these conditions, 0.763, or the machine produces more than 200 watts per kilo. of coiled wire, which represents a work about double that produced by present machines with a lower yield (0.71, 0.677, 0.684 being the yields of the machines IV,, V., and VI., experimented with by the Committee of the Exhibition of 1881).

International Exhibition at Antwerp.

Our Belgian friends are announcing an International Exhibition to be held in the interesting old City of Antwerp, under the patronage of the King of the Belgians. Let us hope that the management will be vastly better than that of Amsterdam last year. We have, however, every confidence of that, as the Belgian people have always shown themselves full of enterprise and energy, and capable of doing business in a business-like way. The Exhibition will open on May 2d, 1885, and will continue for at least five months; it will comprise science and every description of art and industry, and will cover a space of about 54½ acres, close to the Scheldt and the new marine establishments, and while it is going on it is intended to inaugurate the new quay, which is over two miles in length. The circular, issued by the promoters of the Exhibition, states that "the purpose of the enterprise is to favor and develop international exchanges, which contribute so powerfully to the welfare and progress of nations. The Executive Committee addresses its appeal to all nations, and hopes that by the number and merits of their exhibits they will vie with each other in their zeal to unite at Antwerp in 1885 an attractive collection of all the products that interest the commerce of the world. By its geographical position and the ever-increasing importance of its harbor, Antwerp is most favorably situated for this 'rendezvous' given to the producers of all countries. The commercial metropolis of Belgium, so easily accessible, so hospitable to all, will attract in 1885 a vast number of visitors, and it is beyond doubt that in this great center of trade exhibitors will form beneficial connections." We believe that all particulars, together with forms of application for space, can be obtained from any of the Belgian consuls in this country, and we hope to see England better represented at Antwerp than at Amsterdam. No doubt, the Exhibition will put new life into the old Belgian city.—*Mechanical World.*

Electric Light Belting.

It would seem that not the least of the difficulties with which the electric light inventors—Edison, Brush, and others—have had to contend, is that of getting belting that should be of uniform thickness, straight, smooth, and of a strength that should endure the high rate of speed requisite for the dynamos, running, as they often do, at the rate of two thousand revolutions a minute. Seeing the importance of having belts that would transmit the power evenly in order to avoid the flickering, so long a great objection to electric lights, Mr. Lawrence, of Lawrence and Herkner, of New York, began early to experiment, and at last succeeded in overcoming the difficulties, judging from the success which they have achieved.

At a recent meeting of the Society of Arts, Mr. Isaac Probert delivered a lecture upon primary batteries for electric lighting, in which he gave the history of such means of lighting from 1802, when Sir Humphry Davy first showed the carbon arc. The main object of the lecturer, however, was to show the comparative cost of electric lighting by batteries and by a dynamo. Taking the case of a house requiring 100 ordinary incandescent lamps, it was shown that the expenditure of energy in the working of the lamps would be 10.05 horse-power. Allowing for the loss of energy in the dynamo, at least 12.55 actual horse-power would be required from a steam-engine; the weight of coal for which would be about 56 lb., costing (say) 6d. Taking a yearly lighting of 1,800 hours, the annual cost of coal on this estimate would be £45; and the cost of lighting would be £147 a year, or £1 9s. 5d. per lamp, With galvanic batteries, using zinc and strong nitric acid at the rate of 1.03 lb. of zinc per hour horse-power of energy, the consumption of metal for 12.55 horse-power hours would be nearly 13 lbs., costing for zinc alone 2s. 8¼d. per hour. Besides this, the cost of the sulphuric acid to oxidize the zinc, at the rate of 1½ lb. of acid per pound of zinc, would run up the expense to 3s. 11d. per hour. Add to this the value of the deoxidized nitric acid, or 4s. 4d., and the cost of materials alone in the galvanic battery is made up to 8s. 3d. per hour, or £742 10s. per annum. Taking capital into consideration, Mr. Probert brings the cost of every incandescent lamp maintained by battery power to £7 11s. 8d. per annum, as against £1 9s. 5d. with the dynamo. As to the supposed value of the residual products of primary batteries, of which so much is said by various inventors, Mr. Probert thinks the less said the better. In the Telegraph Department of the Post Office no residues are deemed worth preserving except the "black mud" from the Daniell cells, which last year, for the 69,323 cells accounted for, brought in only £167 14s., or rather more than ½d. per cell per annum.

Telephonic News

⁂ All the vessels of the British Navy which carry divers are to be supplied with telephones, for the purpose of submarine communication.

⁂ Atlanta, Ga., has now, under the energetic management of Mr. Gentry, 485 subscribers. We would add that this number for the comparatively small city of Atlanta is a good showing, and speaks well for the management both general and local.

⁂ The police signal boxes in New Haven are to be provided with an apparatus by means of which a red light can be displayed on any of the boxes by pressing a button at police headquarters. The red light will inform a policeman on his beat at night that he is wanted at the signal station to answer a telephone call from headquarters.

⁂ At the regular annual meeting of stockholders of the Central District and Printing Telegraph Company, held Friday the following were re-elected officers for the ensuing year: President, D. Leet Wilson; vice-president, C. O. Rowe; secretary and treasurer, John G. Stoakes; general manager, Henry Metzger. Directors: D. Leet Wilson, Ralph Bagley, George I. Whitney, John L. George, James Merrihew, C. O. Rowe, T. N. Vail, G. L. Phillips, C. R. Truex.

⁂ The executive offices of the New England Telephone and Telegraph Company, in Boston, were removed last week to the new building on Pearl Street, just across the way from that previously occupied. The rooms are very conveniently arranged, and admirably adapted for the purpose. It is expected that the Boston Exchange will be removed into the same building some time in August, provided the new boards get along in time.

⁂ It will not be many days before the wires of the C. & P. Telephone Company will bring into connection with Frederick every place of note in Frederick, Carroll, Howard, Montgomery and Washington counties. The system is rapidly nearing completion. It required energy and push to accomplish so much in so short a time, and too much praise cannot be centered on Supt. Miller for his labor. We are satisfied that General Manager Samuel M. Bryan, himself a worthy man and hard worker, could not have given the Frederick exchange into more competent hands than it is at present.

⁂ It is stated that Dr. Boudet has discovered an improved system of telephony for underground and submarine work. Dr. Boudet has established a derivation in the interior of the condenser, while adding to the latter a third series of tin-foil. This third armature is connected with the line, and is affected by all the variations of charge of the other two armatures. M. Boudet has, by this arrangement, been enabled to telephone on artificial lines, which are very much condensed, and on which ordinary transmitters with induction bobbins gave no result whatever. The experiment has been successfully repeated on a line of the capacity of the Calais-Dover cable. The battery charging the microphone consisted of only two small Lalande and Chaperon piles. It is supposed that the problem of underground telephony has been brought much nearer its solution by Dr. Boudet's invention.

⁂ We understand that Mr. A. W. Gray, manager of the Tropical American Telephone Company, which has established exchanges in Trinidad and Barbadoes, has paid a flying visit to Trinidad; not, however, in connection with the threatened action by his company against the local Government, for the alleged infringement of the Bell telephone patent rights. It is understood that the action, though still in abeyance, is ultimately to be proceeded with. According to Mr. Gray, the telephone exchange in Port of Spain has now upwards of 130 subscribers, and it has been arranged to open a large line between San Fernando and the capital. Notwithstanding its limited population, about 20 subscribers have already been obtained for the branch exchange it is proposed to open in San Fernando, and from 30 to 40 estates in the colony have intimated their readiness to enter the system as soon as the lines can be extended to permit of their doing so.

⁂ The recent observations by M. Thure on the sensitiveness of the telephone to lightning, are but confirmatory of facts in this direction which come from various sources in both hemispheres. According to M. Thure's account, he stretched a copper wire horizontally between two houses at the height of the roofs, and connected it with earth through the water pipes. Two telephones were connected with the aerial line. During every thunder storm, near or distant, that has occurred since this system was set up four years ago, he has been able to hear sounds in the telephones whenever there was a flash of lightning, and this even when there was no thunder audible, so that the lightning was at least some twenty-two miles distant. The sound and the flash seem simultaneous; the former being comparable to the sound of a Swedish match rubbed on the box—that is, a sort of crepitation composed of a very rapid succession of shocks. On one or two occasions there was only one shock, and in some instances the shocks were of a very intense character, resembling the discharge of a strong Leyden jar.

⁂ It is a curious coincidence that a crisis in the telephone question in France is approaching, at the same time that a similar point is reached in the history of the British telephone industry. The two countries have many features in common with regard to this question, the Government monopoly being a recognized fact in both. In neither country have the Government exchanges been successful, although the experiment in France appears to have been attended with somewhat better success than in England. But there are two points in which circumstances in the two countries are entirely dissimilar. One of these is that in France the question of the protection of the telegraph revenue is considered by the authorities themselves as entirely secondary; the other, that the French Ministre des Postes et des Telephones, M. Cochery, in a very praiseworthy manner admits of his own accord, and under no public pressure whatever, the necessity that further facilities should be granted to the telephone companies, and has to this effect introduced a bill in the Chamber of Deputies M. Cochery has decided to entrust, for another lapse of five years, private enterprise with the exploitation of the telephone system in France. The bill will no doubt pass into law, for amongst other reasons, the capital required for the purchase and development of the telephone exchanges would be very considerable, and the responsibility would prove a serious inconvenience in the present state of the finances of the republic. When we mention that the capital at present invested in the telephone in the United States is somewhat near twelve millions sterling, the action of the French Post Office need hardly be further explained. In the *expose des motifs*, however, M. Cochery advances as reasons why the Government could not undertake the responsibility, that the experimental period was not yet sufficient, and that the royalties already obtained by the Government from the telephone company were not to be despised. The first reason is, of course, untenable, and apparently advanced to conceal the impossibility in which the French Treasury finds itself of grappling with the matter. The latter reason we fully admit, and it holds equally good in this country. The income from these royalties for the current year in France is estimated at £11,000, but it seems that an almost equal amount is to be added for taxes paid by the companies and the commission paid to the Government for the construction of exchanges.—*London Postal Gazette.*

The New Telephone Bill in France.

The following is the statement accompanying the proposed bill for the regulation of the licenses for telephone systems introduced by the French Minister des Postes et des Telegraphes in the Chamber of Deputies:

"Since 1879 the use of the telephone was introduced into France. Applications for licenses for telephone exchanges were then addressed to the Ministry des Postes et des Telegraphes. It was difficult, at that period, to be conversant with this new and marvelous application of electricity, or to even suspect the place it would occupy in the habits of life, and to calculate the expense which the establishment of telephone systems would entail. For that reason the Administration could not think of undertaking at once the responsibility and the charge of such work. On the other hand, it would not have been fair to deprive the public of it, or to refuse to it altogether what the Administration itself would not give it. It was thought that it would be necessary, while reserving absolutely the monopoly to the State, to let private industry try an enterprise, the results of which could not well be estimated beforehand. The Minister therefore issued a decree on June 26, 1879, establishing the conditions under which he would grant licenses for telephone systems. Amongst other conditions, he stipulated that the length of the licenses was not to exceed five years, and that 10 per cent. of the gross revenue should be paid to the State. The license did not entail the giving up of the monopoly, as the Government remained free to license exchanges to competing parties or to establish such itself. Three licenses were applied for by the City of Paris and granted. They were later on united and worked by the company known under the name 'Societe Generale des Telephones.' Other exchanges were successively authorized at Lyons, Marseilles, Bordeaux, Nantes, Lille, Le Havre, Rouen, Saint-Pierre-les-Calois, Algiers and Oran. The payment of 10 per cent. of the gross revenue for the benefit of the State produced in

1879.....	2,427.70 frs.
1880.....	15,616.45 "
1881.	55,290.11 "
1882.....	142.637.38 "
1883.....	277,145.95 "
Total for the four years.	433,114.59 frs.

"The amount due to the Government for the first quarter of 1884 is already 63,353 francs 82 cents. The second quarter will reach about 70,000 francs, so that the average for a year from 1884 would be about 280,000 francs, and this figure will increase from year to year. The licenses at present being worked expire simultaneously on 8th September next. It is, therefore, barely time to come to a decision before that date. It is, of course, impossible to deprive the public of a means of communication which it appreciates more and more. It will be remembered that the Administration has made a personal experiment, and has to this effect asked the Chambers for a credit of 250,000 francs. Telephone exchanges have by it been established at Reims, Roubais, Tourcoing, St. Quentin and Troyes. The results of this first experiment may already be called satisfactory, but the experiment is not complete enough for the Administration to ask the Chambers for the necessary credits to work all the telephone exchanges in France. This would entail a large outlay, the amount of which it is impossible to fix at present, and it would compel us to undertake a difficult work, for which we have not got a sufficiently instructed staff. We, therefore, think it will be more prudent to maintain during five further years the licenses granted up till now, and which have, financially, been very profitable for the State. At the same time, it is becoming indispensable to extend the application of the telephone. The working, in the narrow limits which are at present assigned to it, suffices no longer to the wants of trade and industry. We must rise to the level of progress made by neighboring countries. With the object of providing for this necessity, telephone call boxes (cabines telephoniques), open to the public, should allow everybody to communicate during certain hours with the subscribers of the system, or with other telephone call boxes established elsewhere, against a charge fixed in accordance with the act of April 5, 1878. We shall simultaneously continue an experiment for establishing Government exchanges. We shall also be able to connect towns and cities by the telephone. This is the scope of the bill which we submit to you. The rights of the Government are, moreover, absolutely reserved. No monopoly will be granted, the Administration will always be able to grant competing licenses, or work them itself. It will also keep the absolute control of the systems worked by private enterprise. It finally reserves the right of purchasing at any time the exchanges worked by others."

The Baudot Telegraph System.

The Multiple Telegraph of M. Baudot, telegraph engineer, has, during the last two years, undergone important modifications in its principal organs; such as a new relay, a new printing apparatus, called by the inventor a translator ("Traducteur"), and the appliance of this translator so as to allow it to be used on a line connected with a multiplex distributor or for simple transmission. In the latter case it can be printed duplex, and furnishes two messages at the same time, instead of four or six in the first case. It may be of interest to give accounts of the number of apparatus installed in France. The multiplex apparatus functions at present in France in the lines from Paris to Marseilles with relay at Lyons sextuplex; from Paris to Bordeaux, Lyons, Lille, and Avost quadruplex; Marseilles to Lyons, quadruplex; Bordesin to Toulon, triplex; from Bordeaux to Toulon, quadruplex. It is about to be installed as triplex between Paris and Brest. Between Paris and Havre messages are sent by one wire and received by another, which makes eight simultaneous transmissions by the same Baudot apparatus. This arrangement has been rendered necessary by the pressure of messages caused by commercial transactions during certain hours of the day. The Simplex and Duplex apparatus was introduced last year in the underground lines from Paris to Lille, and Dijon, and on the overhead lines from Marseilles to Lyons, Bordeaux and Vico, from Lille to Havre, from Paris to Brest, and from Bordeaux to Toulon; it is at present being introduced between Nantes and Paris. The following are the figures of transmission obtained by the Baudot apparatus in the month of February, on the line from Paris to Marseilles:

4	February.....	1,800
5	"	1,720
6	"	1,770
7	"	1,880
8	"	1,810
9	"	1,630
11	"	2,000
12	"	1,550
13	"	1,685
14	"	1,180
15	"	1,640
16	"	2,000
18	"	2,250
19	"	1,950
20	"	1,730
21	"	1,830
22	"	1,720
23	"	1,670
25	"	2,090
26	"	1,010
27	"	1,770
28	"	1,880
29	"	1,840
1	March	1,540

The average per day is, therefore, about 1,800 messages. The superiority of the Baudot system over that of Meyer (Morse multiplex) appears now to be generally admitted.

Proposed Telegraph Consolidation.

Persons interested in bringing about a consolidation of the Baltimore and Ohio, the Postal, and the Bankers and Merchants' Telegraph companies have held frequent conferences, but no definite plan has yet been agreed upon. President Bates, of the Baltimore and Ohio, says: "Such a scheme is being talked of, but I am not at liberty to say anything about it at present." Vice-president Cummins, of the Postal, says:

"The matter is being discussed, but it has not been brought to a focus yet." It was stated by other persons that the agreement between the three companies will be based upon the business of the companies up to July 1.

The termination of the litigation between the Baltimore and Ohio Telegraph Company and the Western Union will enable the first-named company to open several new wires East and South. The new line to Boston, it is expected, will be ready for business within a few days. The Baltimore and Ohio company proposes to reduce its through rate from New York to Chicago from forty to twenty-five cents about the middle of this month.

Comment and Criticism.

The increasing number of international scientific congresses, whose function is the establishment of common points of departure, and the unification of standards of measure both as to dimensions and nomenclature, is a hopeful sign of progress towards the "millennium," to which men of science are unquestionably nearer than their political brethren. It is delightful to find that there are so many important matters concerning which scientific men, representing many nations and many languages, find themselves in perfect agreement. Although in many instances a surrender of some personal or patriotic claims has been demanded, this has been generally acceded to with little protest, to the end that universal advantage may be the outcome. When work of this kind is done, it should be done for all time to come; at least, what is definitely fixed upon should be of such a nature that it will not need undoing in the near future.

In this respect the report of the electrical congress is something of a disappointment. The congress seems to have reached its conclusions in undue haste. Indeed, the electrical units, as now defined, are less precise and scientific than before. The reference of the practical units to those of the c. g. s. system was in itself admirable and satisfactory. With the new definitions, one only, that of current strength, has a precise relation to the fundamental units; the others have become arbitrary. Would it not have been better to adhere to the original ohm, and to define the mercury unit as provisional? The new mercury unit is obtained from measurements that differ among themselves by more than two per cent. Besides, the verdict was made up before the results of Professor Rowland's exhaustive investigation, now in process, were in the possession of the congress, although this investigation was admitted to be one of the most important. A provisional mercury unit of a hundred and six centimeters would have satisfied all practical demands, and would have been subject to such correction as future research indicated to be necessary. As the matter now stands, the elegance and simplicity of the system is destroyed by the introduction of arbitrary units, the value of which may some time be found to be considerably different from that now assumed.

While the congress might have acted more wisely, in the opinion of many, in the matter of the ohm, in its definition of the standard of light it would certainly have done well to postpone action for the present. It appears, that, because nothing better was offered, the square centimeter of fused platinum was adopted. Although this is a matter which is greatly in need of adjustment, there can be little satisfaction in the adoption of what is, as nearly as may be, an impossible standard. There must have been a paucity of suggestions as to a suitable standard; which is singular, considering the prominence of the problem of measuring intense lights. And in recommending that all records of observations of atmospheric electricity and earth-currents should be sent to the international bureau at Berne, the congress simply acknowledged our present ignorance.—*Science.*

Atlantic Cable Competition.

The present position of Atlantic cable business may be fitly described as "the calm before the storm" The new Bennett-Mackay cable is not yet completed, and so the existing Atlantic cable companies hold their hands and charge their old rates. But there is no doubt but that the very day on which the new cable is opened for traffic the rates will be very materially reduced. More appears to transpire on the other side of the Atlantic as to the proposed tactics of the adversaries than on this side.

The cable companies forming the "pool," we are told, are now organizing for better competition against the new enterprise, and have agreed to make a united effort to crowd their opponents out of the field by charging the extraordinary low rate of six cents per word as soon as the new cable is ready for business. The Commercial Cable Company, in response to this challenge, say that their cable, which will be complete and in good working order about the middle of next month, will carry messages for the public at this rate of six cents, and will be far more able to keep up the struggle on that basis than the other companies with their inflated stock and old cables. At the same time preference will be given to full-rate messages—by which, we suppose, is meant messages at twenty-five cents per word—in the order of their filing.

But the New York *Herald* people assert that even if public patronage were largely drawn away from the cable, they could still find constant employment for it; and if Mr. Bennett intends, as rumored, to start a daily *Herald* on this side, outside business, it is argued, would be of secondary importance. It is expected, however, that the new cable will take its share of all the business going, and this share has been sanguinely figured out at five million words per annum, or ten million words for the two commercial cables. It has been arranged that after the business handed in by the public shall come, in the order of transmission, press messages, other than those addressed to the *Herald*, and that that paper's dispatches, except those of an urgent character, shall form a third and last class. As it is put by the *Herald* people themselves, they will "jump in" with their own messages at all spare times, not allowing the cable to have a single idle moment.

This is all very well, but a great deal of it must be considered as empty talk. The amount of business which would flow to the new cable at very low rates would soon block out not only the *Herald* people, but also the whole of the press messages. But if preference is to be given to full-rate messages, those at the lower rate will, on account of their slow transmission, lose their value.

Neither Stock Exchange, commercial, nor press messages allow of delay, and if the *Herald* is to fill out the pauses, its news will probably be very stale when it gets to its destination. It is also probable that a system of what we might call boycotting would be adopted by the old companies, by which regular customers of the new cable would be excluded from their system. The struggle will be severe, but its issue will, we opine, be favorable to combination, whose management is in such powerful and skillful hands. —*Telegraphic Gazette.*

Telegraph in Albany.

THE FIRST GOVERNOR'S MESSAGE SENT ON THE WIRE—ORIGIN OF THE STATE ASSOCIATED PRESS—IMPROVEMENTS IN THE SERVICE—INTERESTING INCIDENTS.

Telegraphing was first introduced to the people of Albany in 1846, soon after the perfection of experiments in electricity, when the New York, Albany & Buffalo Company opened an office "for the transmission of words by lightning" in the old Exchange building, January 31. The first wire strung was from Albany to Utica, and later, September 9, it reached Buffalo. By the middle of July New York city and Albany were in communication with each other by a single wire. On New Year's day, 1847, the President of the company, Mr. Faxton, of New York, signed articles of agreement, with the proprietors of *The Journal* and other representative newspapers in the State for exchange of news items. This was the origin of the State Associated Press.

THE FIRST ASTOUNDING THING.

Five days later the world was astonished by seeing Governor Young's message "sent out by lightning," over telegraph wires, and received by enterprising newspapers and published. The message sent from Albany contained 5,000 words, and probably was the first public document ever transmitted by telegraph to the press of the State. In the year 1847 an opposition was found in the Bain Telegraph Company, which had extended its line to Albany from New York along the west shore of the Hudson and opened an office in the Museum building.

THE FIRST CONSOLIDATION.

In a few months later the House Printing Telegraph Company entered into competition with the other companies and the three struggled for existence until 1852, when the Bain passed into the hands of the New York, Albany and Buffalo Company, followed in 1856 by the House Company. The Western Union Company, whose lines did not extend east of Buffalo, purchased the consolidation known as the New York, Albany & Buffalo Company in January, 1864. The House printing machine was in use until 1847, and the first discovery that messages could be taken by sound was made by an Albany operator and is recorded in Reid's History of the Telegraph in America, as follows:

TELEGRAPHY BY SOUND.

One day in May, 1847, while an operator in the Albany office was receiving from Utica a reply to an inquiry about a train, the paper in his receiving-instrument suddenly stopped, and he lost the words then coming. Another operator, the late W. C. Buell, of Troy, sitting near at the time, said: "He says the nine o'clock train arrived on time." How Buell knew what Utica said was a mystery, even to himself, but he had simply done what all operators now do—read by sound. This is one of the earliest cases on record of sound reading. Mr. Ten Eyck, of *The Evening Journal*, who was present, made it the subject of an article so interesting that it was extensively copied in Europe.

REMARKABLE IMPROVEMENTS HERE.

The improvements in telegraphy which are apparent in the Western Union office in this city are remarkable. The chief operator, Mr. M. L. Morgan, and the cashier, Mr. George P. Riley, have experienced what mutations have marked the Western Union Company in Albany, they having served for more than twenty-two years in various departments. The office in the Museum building has finally reached a state of perfection. The business office on the first floor is finished in solid cherry and is separated from the manager's and cashier's departments by an unique glass railing and cherry counter. Convenient public desks of like wood are erected about the walls of the rooms. The operating room occupies the entire fifth floor, and the whole of the fourth floor is devoted to the batteries, in which there is an aggregate of 3,200 cells.

THE CORPS.

Mr. Frank W. Sabold is the manager. His corps consists of Mr. Riley, cashier, with two bookkeepers, Messrs. John J. O'Connor and C. S. Follett; five clerks, Messrs. E. D. Osborn, J. T. Seery, T. F. Callahan and H. A. Mooney, with Mr. M. A. Feeney, delivery clerk; two office boys and thirty-two messengers in one department. Mr. H. V. Shelley is the night manager. In the operating department are Mr. M. L. Morgan, chief operator, Mr. S. C. Rice and Mr. C. C. King, assistants, thirty-one operators and three office boys. These do not include the attaches in the seven branch offices in the city. The equipments for this office must have cost an inestimable sum of money, as they consist of most-complicated and accurately-working machines invented for use in telegraphing.

THE APPARATUS.

There are five sets of quadruplex and one set of duplex instruments, thirty-nine sets of Morse instruments, thirteen sets of repeaters, and the most wonderful of all is a complete apparatus for electrical testing and measuring. These last-named instruments were made by Professor Siemens, of London, England. They are most delicate and handsome, yet their appearance would scarcely indicate their importance. By this apparatus "line troubles" are located accurately for great distances, so that instead of going in search of the defect, as was the custom a few years ago, the linemen are directed to the location of the disturbance by machinery. When one considers that from this office all the lines within a radius of one hundred miles are cared for, the great value of these instruments becomes apparent.

TELEGRAPHIC

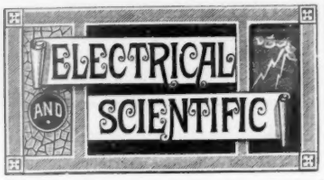
.... Card telegrams are much in use in Paris. There are two kinds of them—one like the ordinary postal card in form and color, and the other blue, and capable of being so closed as to conceal the writing. They are large enough to contain a message of fully sixty words. When a card is dropped into the card-telegram box of the nearest telegraph office, the official in charge picks it up, and has it transmitted through one of the pneumatic tubes which extend all over the city, thus insuring its delivery at the place to which it is addressed in less than half an hour from the time it is posted.

.... A remarkably laughable incident occurred near this city during a thunder storm a few days ago. The workmen who are stringing the new telegraph line had a coil of wire partly up on the insulators while the main coil was still on the reel in the wagon. There was a vivid flash of lightning, and the man who was attending to uncoiling the roll of wire was seen to spring from the wagon, drop upon his knees in the muddy road, and, amid the descending torrents of rain, was heard to pour forth a fervid prayer and at the same time confessing his past sins. It took the rest of the gang some minutes to convince the man that he was not struck with lightning, but had been merely shocked by an overcharge of electricity.—*Oil City Blizzard.*

... Within the last few months many improvements in the telegraphic department of the Reading Railway have been made. Telephones have been placed in offices where operators are not required. The Fourth Street office, Philadelphia, has been thoroughly renovated, and new tables, instruments, switchboard, and many new circuits are among the paraphernalia of the office. Eighteen instruments are in place, and the office is under the management of Mr. H. G. Kepler, who is well liked. Wm. Mishler is chief operator. The Atlantic City line has been connected at Winslow Junction, giving a through wire from the former point to Jersey City via Philadelphia. The Reading covers a large territory, and the interchange of telegrams is heavy.

... M. Seligmann-Lui concludes by adducing figures to show that the cultivation of gutta-percha would be commercially successful. From the chief market, Singapore, 14,500 pikuls were exported in 1876, and 62,000 pikuls in 1881. Prices have doubled and quadrupled since 1875, and even at the present value the article is scarce. An almost limited demand exists for it, and large quantities could be easily placed at remunerative prices. The price of gutta-percha of medium quality and mixed with impurities is at least six times that of coffee and thirteen times that of sugar. There is little doubt that the cultivation of gutta percha will pay, and as there is great danger of the supply at some time or other being exhausted, it is to be hoped that M. Seligmann-Lui's recommendation will be acted upon.

.... The telegraph lines in Tunis are exclusively in the possession of the French Government, and have been much extended since 1881. Formerly only a line along the Tunisian coast to Algeria was used, also one to Sfaks in the south, and one *via* El-Kef to the Algerian frontier, but now the telegraph penetrates not only the whole of the north of the regency along the line of railway Tunis-Ghardiman, but the whole of the interior. Kairuan in the center, and Gaffa in the south, are now within its reach. There are nearly 50 stations, of which half have a military and the other half a civil character. The staff numbers about 200. Cable communication to Sicily, which existed formerly, is at present interrupted. It is to be hoped that the Tunisian telegraph system will soon be extended to Tripoli, which is now connected with Malta by an English cable. The charges for the use of this cable are stated to be so enormous that the Tripolitans would avail themselves with advantage of the connection *via* Tunis and Algeria with Europe.



* * Mr. J. A. Pond, of the New Zealand Institute, has given an account of the rare discovery of platinum in a vein. It has been found in octahedral crystals in a quartz vein in the Thames gold district.

* * At the Turin Exhibition a street railway is to run from the Piazzo Carlo Felice to the principal entrance of the building. The motive power will be supplied by electric accumulators invented by Signor Nigra.

* * An international exhibition of metal work is to be held next year at Nuremburg, which will contain specimens of the art of the worker in brass and copper, together with the machinery and appliances used for metal work The exhibition will be open from the middle of June to the end of September.

* * A New Mexico paper announces the remarkable discovery of a vein of natural coke at Los Cerrillos. The vein is three feet thick, and lies between a stratum of bituminous and anthracite coal. The coke has the appearance of the manufactured article and burns with a clear, bright light. It has been tried in furnaces as being better, if anything, than the coke made in ovens. The theory of the phenomenon is that the vein was originally coal, and was brought to a white heat at the big upheaval thousands of years ago. Water coming in contact with the bed of the burning bituminous coal cooled it off and turned it into coke.

* * A recent edition of the New Orleans *Picayune* was printed on paper made of bagasse, the refuse of sugar cane after the juice is squeezed out. This event has created a stir in several quarters. The sugar planters of Louisiana, who have burned this hitherto worthless stuff to get rid of it, now see a possibility of making money out of it, and a few enthusiasts reckon that it will be nearly as profitable as the sugar crop. Within a generation the cost of producing paper has been greatly lessened and the quantity produced enormously increased by the discovery of economical ways to use new fibers as material for this commodity.

* * Mr. Reckenzaun, the *Engineer* is informed, is endeavoring to overcome the various difficulties connected with the use of secondary batteries, and has worked out a system for working street railways electrically at a smaller cost per car mile than is possible either with horses, steam, or compressed air. The rails laid down for horse traction are sufficiently strong for his car, and the load is distributed in such a way that with a car loaded to its maximum number of 46 passengers the pressure upon any pair of wheels will not exceed two and one-half tons. The motor, which was exhibited at the Society of Arts, London, is light in comparison to the power it develops.

* * M. Lazare Weiller has conducted a series of valuable experiments with the object of ascertaining the relative electric conductivity of metals, submitting the results to the Societe Internationale des Electriciens. They are referred to a pure silver wire, one millimeter in diameter, and having a resistance of 19.37 ohms per kilometer at 0 degree Celsius, as a standard. The following are his figures:

	STANDARD
Pure silver	100 00
Pure copper	100.00
Silicon bronze (telegraph)	98.00
Alloy of equal parts silver and copper	86.65
Pure gold	78.00
Pure aluminium	54.20
Silicon bronze (telephone)	35.00
Pure zinc	29.90
Phosphor bronze (telephone)	29.00
Alloy of equal parts silver and gold	16.10
Swedish iron	16.00
Pure Banca tin	15.45
Ten per cent. taluminium bronze	12.60
Siemens steel	12.00
Pure platinum	10.60
Pure lead	8.88
Pure nickel	7.89
Antimony	3.88

* * The New York, West Shore, and Buffalo Railway is equipped for eleven miles near West Point with electric block signals. Great precautions and large expense were incurred in order to pass West Point without interfering with the facilities for artillery practice, which was so far accomplished that nothing but a wild shot can touch the track or train upon the track. A wild shot was fired, however, a few days since and a 400 pound shot struck one of the 67 pound rails. The long angle fish plates broke, and the rail was forced out in the middle into a U form. Danger signals were immediately set in both directions by electric apparatus, which, if a train had been approaching within a little distance, would doubtless have prevented a serious accident.

* * At the monthly meeting of the Board of Managers of the Franklin Institute at the Institute, the preparations for the Electrical Exhibition were reported as progressing favorably and rapidly. Many appliances for telpherage, or carriage by electricity, and telemetry, or measurement by electricity, have recently been entered for exhibition. Over six hundred volumes of works on electricity have been received and catalogued for the historical library in course of formation. The Board of Public Education has made arrangements to allow the pupils of each of the public schools in the city to visit the exhibition. A series of lectures are being arranged to take place, to be delivered by the most prominent men engaged in the study of electricity in this country and in Europe.

* * A Southern journal, which appears to have given much attention to the matter, tells us that the amount of capital invested in manufacturing and mining enterprises in the Southern States, during the first two months of the current year, was $28,200,000. Of this sum the largest portion was invested in Kentucky, where $6,851,000 were represented in various industries. Capital to the amount of $5,210,000 was placed in Alabama, and in other States the following sums were invested: Virginia, $3,830,000; Texas, $3,593,000; Georgia, $2,074,000; Maryland, $2,015,000; North Carolina, $1,227,000. It further says that the cotton mills now building and those started since the first of the year add more than 100,000 to the number of spindles now in the South, and will represent an outlay of more than $3,250,000.

* * A process for nickel-plating without the battery has been described by Stolba, who claims that by means of it he is able to coat satisfactorily small articles of zinc, cast and wrought-iron, steel, and copper. A concentrated solution of chloride of zinc, diluted with twice its volume of water, is boiled in a copper vessel, adding a few drops of muriatic acid should there appear a precipitate of basic chloride of zinc. When the introduction of a small quantity of powdered zinc causes a deposit of zinc upon the vessel, enough chloride or sulphate of nickel is added to the bath to give it a distinctly green color, and then the previously cleansed articles are plunged into the liquid in contact with zinc, where they are allowed to remain for about 15 minutes, the boiling temperature being kept up meanwhile. If the objects are not at first coated sufficiently, the immersion is repeated until the desired thickness of deposit is obtained.

* * The ancient city of Antwerp is about to add one more to the plethora of forthcoming exhibitions. It proposes to hold a Universal Exhibition next year, and a committee of organization was recently constituted under the presidency of M. Victor Lynen, an influential merchant of Antwerp. The committee are, says the *Machinery Market*, certainly going about their business in a more energetic and promising fashion than their neighbors did at Amsterdam. They have decided that this exhibition must not be a financial speculation, but a national undertaking. They, therefore, offer to the public the greater portion of the capital of the Societe Anonyme, which was constituted for the organization of the exhibition. The result of the sale of the 18,100 shares thus offered will show whether the project can be realized, or whether it will have to be adandoned. So far, it is understood, the support accorded has been very encouraging. On the whole, although we have now-a-days far too many "Universal" Exhibitions, the scheme, from an exhibitor's point of view, seems worthy of support. If, however, the exhibitors do not profit by it, the city of Antwerp probably will and deserves to, for "Busy Belgium" is just at present expending some £4,000,000 on the improvement of its port and commercial facilities. The committee state that this universal exhibition will take place under particularly economical conditions.

On the Causes of Disturbance in Telephonic Communications.

According to the observations made by M. D'Arsonval, it appears that the nerve of the frog, which has always been regarded as the most perfect of all galvanoscopes, is 200 times less sensitive than the telephone. But the experiment of M. De Moget proved that the amplitude of vibration of the plate of the transmitter is 1,800 times greater than that of the corresponding receiver, and, without considering the losses sustained upon the line, we must attribute a considerable portion of the results obtained in telephony to the perfection of the organ of hearing.

Whatever may be the cause of this extreme sensitiveness, it exists, nevertheless, and must be taken into consideration if we wish to eliminate the disturbing effects which disguise or diminish the power of the voice.

The causes of these disturbing actions exist, either at the transmitting station, on the line, or at the receiving station, but very often at all three of them at the same time, so that an analysis of the special conditions in each case, says Mr. E. Van Hoey, in *L'Ingenieur Conseil*, becomes absolutely necessary.

Taking into account only the essential parts: A microtelephonic station comprises a microphone transmitter with battery, a call bell with or without battery, and a telephone receiver, and a purely telephonic station; a call bell with battery and a telephone serving at once as transmitter and as receiver.

Most generally, all this apparatus is assembled upon one board, which is fixed to one of the walls of a room where the speech is transmitted and received.

So long as we have a purely telephonic communication, this mode of grouping all the elements of a station has no disadvantages; but when this arrangement is used for a microtelephonic station, inconveniences may result in certain cases, as we shall see directly.

The battery most generally used for telephony is the Leclanche, with porous cell. It is composed, as we know, of a glass jar containing a solution of chlorhydrate of ammonia; in this is immersed a porous vessel, which contains a mixture of carbon and peroxide of manganese, surrounding a plate of carbon. This latter forms the positive pole of the battery, the negative pole being a zinc rod immersed in the solution of chlorhydrate.

Without describing accurately all the reactions which take place during the passage of the current, we may say that there is, on one hand, a formation of oxychloride of zinc, and, on the other, the reduction of the peroxide of manganese with disengagement of ammoniacal gas. From this we may conclude that in putting into the battery sufficient water to insure its working properly, we must avoid inundating the mixture contained in the porous cell; for a too strong imbibition of the carbon and peroxide of manganese would result in preventing the disengagement of ammoniacal gas and producing polarization of the element.

In this case the battery would not work as well, the current strength would be lower, and consequently the speech in the receiving apparatus would not be as loud. We think that it is best to have the liquid in the glass vessel one-half of the height of the porous cell.

This precaution does not seem to be taken generally, if we consider the rather numerous cases of batteries in which the porous cell is too much submerged, although, for several reasons, it should be specially attended to in installations of this kind.

If we now examine the phenomena which occur in a battery in the normal state of construction and mounting, and which is placed in a position where the temperature is more or less high, we shall soon see that crystals are deposited at once upon the glass vessel, upon the porous cell and upon the zinc rod.

Following this examination more attentively, we observe that these crystals are not of the same nature, and, whilst the first are formed of chlorhydrate of ammonia, chloride of zinc enters into the composition of the second.

The following experiment, which may be made for this purpose, completely proves the difference of substance of the crystals, which are deposited upon the vessel and upon the zinc:

Having thrown chlorhydrate of ammonia into a glass vessel containing water up to one-third of its height, and placed in a room having a mean temperature of about 15° C., we may observe, at the end of the third or fourth day, the presence of a light deposit of salt forming a band above the surface of the liquid. This band increases continually in width, and after about a month reaches the top of the vessel, and then re-descends in a progressive manner upon the outside of the receptacle, and reaches the bottom in about two months and a half.

Whilst the band is developing thus daily, the deposit of salt which forms it, and which appears at first like a sort of dew, offers successively more abundant and more regular crystals, which constitute the creeping salts.

They creep, in fact, actually along the surfaces of the cells, and, as soon as a slight layer is produced by the evaporation of a portion of the liquid, this, drawn up by capillary attraction between the walls and the small crystals already formed, strengthens and regulates them.

If, after having proceeded in this manner, we continue the experiment by immersing a rod of zinc in the solution of chlorhydrate, we perceive no change in the phenomena, which remain as they were. No chemical action is manifested by any change whatever of the creeping salts, nor are any crystals deposited upon the zinc rod.

It results from these facts that the crystallizations which we observe upon the vessels are different from those upon the zinc, and that the first, which are produced in a liquid containing only chloride of ammonium, can only be formed from this salt.

Those, on the contrary, which cover the zinc, and which only exist in batteries which have already worked, are formed of the chloride of this metal, as M. Wurtz said, in his dictionary of chemistry.

This last point may, however, be explained as follows:

The chloride of zinc which is produced under the action of the electric currents requires, in order to be dissolved easily, a liquid containing chlorine, and as soon as this becomes deficient it is deposited in the form of crystals, falling to the bottom of the receptacle. The formation of the creeping salt, which impoverishes the chloruretted liquid intended to dissolve the salt of zinc, is therefore the cause of the deposit of crystals from it.

Therefore, in order to have a good reproduction of the speech, we know that it is important that the battery be in special conditions, which, although not completely preventing the formation of the creeping salt, nevertheless retards it.

The presence of these salts, in fact, leads directly to a diminution in the quantity of active liquid, and causes during the working of the battery the formation of crystals upon the zinc, which prevent it from being attacked, and increase the resistance of the element.

We have seen that a certain degree of heat sensibly favors the production of crystals of chloride of ammonium upon the vessels, and that the condition necessary for retarding this as much as possible is placing the battery in a place where the temperature is low. It follows, therefore, that by grouping upon the same board all the apparatus of a microtelephonic station, including the battery, the

desideratum mentioned above cannot be realized under all circumstances.

No more need be said on the subject of disturbances caused by the special conditions of the battery.

We will now study the microphone transmitter, which forms the second apparatus of a microtelephonic station.

The most important element which enters into its composition is certainly the carbon, of which the nature and condition exercise a very great influence upon the loudness and clearness of the speech.

It must not be powdery, for instance, for by the vibrations, which are, so to speak, continual, to which the apparatus is subjected, the molecules of carbon are accumulated between the contacts and produce a disagreeable crackling which accompanies the voice.

Other organic powders (dry, like the first) produce, moreover, the same effect, and like them may be momentarily dislodged by a few sharp blows given by the person speaking upon the box of the transmitter where these derangements appear.

Very often M. Carré's electric light carbons are used. These are prepared by pulverizing, compressing and subjecting to a high temperature in crucibles a mixture of very pure coke in fine powder, calcined lamp black and syrup of sugar.

On examining with a lens a carbon thus prepared, we find a certain number of small white points apparently formed of crystals of sugar not completely carbonized. They exist tolerably regularly in the entire mass of carbon, and impregnate the surface with a slight dampness, which by their nature they extract from the surrounding air. This effect is soon followed by the disintegration of the carbon and the formation of a humid powder, which is very hard to detach from the contacts. We may, however, do this by passing a strip of very clean paper over them.

In order not to be obliged to do this too often, it is desirable to remove the cause of the formation of this sort of powder, by removing every trace of the white points by perfectly polishing the surface of the carbon, so as to give it the appearance of a metallic body.

There remains now only a very little to be said about the bell, the line and the telephone, which form the last parts to be examined.

As regards the bell, we may clearly state that the preference should be given to the magnetic bell; that is to say, that working without a battery, because of the numerous advantages which it possesses, amongst others, the insuring of better contact. This removes one cause of weakness of voice which occurs rather frequently in apparatus where this contact is only made in an imperfect manner.

The line is sometimes also the seat of disturbances, especially when it has a rusty or badly soldered joint, for then the resistance of the circuit increases, and the intensity of the current is consequently diminished.

It may happen, also, that the wire touched a conductor in communication with the earth; another line, for instance. In this case, the leakage thus accidentally introduced diminishes the resistance of the circuit and increases the total current strength which is divided at the point of contact in inverse proportion to the resistances of the paths open to it. Consequently, the current which actuates the telephone receiver is always weaker than when the line is in the regular condition, that is to say, when there are no abnormal leakages.

A similar weakening of the current may result from the bad insulation of the line upon the poles, as well as from the employment of a bad communication with earth.

As regards the telephone, we may say that the only defect which it can present is an undulation which the vibrating plate takes when the apparatus is kept in a damp place, or when it serves as a transmitter. In these conditions, in fact, the aqueous vapor is condensed upon the plate, and attacks the metal with whatever varnish it may be covered. At the point where rust is formed, that is to say, at the center which is most exposed to dampness, the plate is no longer in its normal condition, and owing to the combined action of this dampness and the attractive force, it takes a concave curvature toward the middle of the apparatus.

This modification sometimes causes the plate to stick to the magnet, and prevents all speech. It is necessary in this case to heat the apparatus, the plate then resumes its original form. Sometime the defect is not as pronounced, but it has always enough influence to alter the tone of the apparatus.

Thus are expressed broadly the causes which produce a weakening of the voice in telephonic communications, and the means of preventing or lessening them.

The Limit of Telephonic Development.

It would be somewhat early days to discuss the limit of telephonic development in this country, where its progress has been stunted by numerous restrictive enactments. But it is not surprising to find our American cousins considering the question, what highest telephonic development may reasonably be expected? In the United States the telephone has taken root, and flourishes in no ordinary degree, and so utterly unhampered has its extension been in that country, that the maximum development may, perhaps, be almost reached in the oldest telephonic territories. There would, of course, be room for a certain rate of increase of subscribers in proportion to the increase of the population and the progress of trade and commerce in such districts; still, at moderate prices, and with all facilities within reach, it may be taken for granted that three or four years would suffice to thoroughly introduce the telephone system in a given area. Such an area appears to be that of the New England Telepone and Telegraph Company, which contains some of the oldest telephonic territory in the States. Taking twelve of the principal cities in its district, we find that the proportion is one telephone to every 83 of population. Taking, on the other hand, twelve of the principal cities in the Erie territory, and estimating the population from the most reliable data at hand, we find that the proportion is one telephone to about 105 of the population. As to the progress of this latter district, which is operated by the Erie Telegraph and Telephone Company, the statement made by the directors of that Company to the meeting of shareholders held on the 9th inst. furnishes full particulars. While on June 1, 1883, the number of subscribers connected was 5,739, it had grown to 8,942 on March 31, 1884, showing an increase of 3,203 subscribers in ten months. Referring to the possible limit of the increase in subscribers, the directors fully expect that they will also reach the rate obtained in the New England district, and, considering the progress made during the ten months, it would appear that this is not by any means an overestimate. We cannot help envying our American cousins the unrestricted development of their telephone systems, and as naturally we are inclined to ask ourselves, what might not be achieved in this country under similar circumstances? A rate of one telephone to 83 inhabitants, if applied to our large manufacturing districts, where a similar development as in the New England or the Erie districts might be expected, would give enormous figures — figures compared with which the present numbers of subscribers to the telephone exchanges in this country (about 11,400) are utterly dwarfed. We cannot, of course, expect to obtain a telephone to 83 inhabitants throughout the United Kingdom, but then this would work out to almost half a million of telephones; and, all things considered, there is no doubt that the number of telephones in the country might some day be written with six figures. Unfortunately, with the unreasonable and unfair gagging policy pursued by the Postmaster-General, there is at present little chance of progress being made which, in the remotest degree, could be compared to that achieved in the United States; but we cannot believe that the public will much longer put up with the present state of things. The agitation in favor of proper facilities being granted to the telephone companies may be expected to grow to very large dimensions for the feeling is becoming very general that mistaken views as to the protection of the telegraph revenue must not prevail against the interest of the public.—*The Telegraphic and Telephonic Gazette, London.*

It costs forty cents to telegraph nine words from Philadelphia to West Philadelphia, and it takes five hours for the message to reach its destination. The people complain, but they should not do so. Forty cents for five hours of the company's time is cheap.

— It often occurs in establishments supplied for the first time with electrical appliances that engineers and others are placed, after a short period of instruction, in charge of dynamos and electric motors. To these men, experienced as they may be in steam engineering or as firemen in charge of boilers, the introduction of electrical terms applied to systems of lighting, and the unfamiliar names given to machines and their parts are confusing and mystifying. In one of our large factories, after the dynamos for incandescent light had run only a few hours, the bearings of the commutators showed signs of heating. Following out the practice pertaining to similar difficulties in steam engines, the person in charge of the motor tried the effect of plumbago mixed with lubricating oil. The result was, as might have been expected, the plumbago applied to the commutator being an excellent conductor, a short circuit was formed, rendering it necessary to stop the dynamo until the difficulty was remedied.

After this experience the engineer, a most capable man in the sphere to which he was accustomed, carefully removed the disturbing element, and remarked the next day, that "since the *commodore* had the *lumbago* the trouble was over."

— Our contemporary, London *Engineering*, calls attention to a very interesting installation that has just been completed at Lindon Park, near Hawick, in Scotland, the residence of Mr. Walter Laing. The grounds, within which the residence is situated, are traversed by a small stream, which is a feeder of the Teviot, and that has been taken advantage of to obtain the power for producing the current. The number of lights required were estimated to absorb about eight horse-power, which was more than could be obtained directly from the stream in dry weather. It was determined, therefore, to construct a reservoir in the bed of the rivulet, in the shape of a small lake of about an acre in extent. The stream may be depended upon to give in the driest weather a minimum of 80 cubic feet of water per minute, which, being stored in the reservoir during the day, is found to be more than sufficient for working the turbine, which requires 270 cubic feet of water per minute, with a fall of about 18 feet. It is connected by means of a short belt with a Siemens self-regulating dynamo, capable of supplying the requisite current to 70 Swan incandescent lamps of 16 candle-power each. Altogether, however, about 100 lamps have been fitted up; and of those 70 can be worked at once, and all or any can be turned on or off at pleasure. In most cases the lamps are of 16 candle-power, but a few of them have twice that lighting power. About 80 lamps are distributed through the house, no other kind of light being provided for. Swan lamps are fitted up in the stables, and there are twelve outside in the avenue, all of which are controlled by means of one switch near the hall door, and can either be lighted or extinguished at pleasure. The distance of the turbine and dynamo from the house is about 350 yards, and that from the house to the lodge about 400 yards, so that a circuit approaching a mile in length must be traversed by the electric current in reaching the farthest lamp. Neither turbine nor dynamo requires much attention, practically all that is necessary being to turn on the sluice valve, which admits the water to the turbine when the lights are needed. For stopping the turbine at night, when the lights are no longer required, a simple electrical arrangement has been designed, by means of which the sluice valve can be closed from the house.

ELECTRIC LIGHT NEWS

— When the electric lighting of the Paris Opera is completed there will be no fewer than 4,000 glow (incandescent) lamps distributed throughout the house.

— The Marshalltown Electric Light & Power Company, Marshalltown, Iowa, is now in successful operation. Their power is furnished by a Westinghouse automatic engine of 65 horse-power.

— Small boys who are in the habit of tossing wires over the cables or wires of the electric companies may well take warning from the fate of a Connecticut child who was instantly killed by diverting the current from an electric light wire.

— Mr. Crosby, General Superintendent of the Ohio Paper Company, says that the Edison incandescent plant in their mills at Niles, Michigan, has been in operation ten months satisfactorily, and that $5 will cover all expense of repairs on the machines to date.

— The extensive use of electric lights in a number of prominent buildings in Chicago, adds greatly to the appearance of downtown streets during the evening. The excellent qualities of the lights displayed on the State and Monroe street fronts of the Palmer House are especially noticeable. The Western Electric Company, of Chicago, have placed over thirty of their lights in this hotel during the past few weeks.

— MM. de Meuron and Cuenod, of Genoa, have fitted up the appliances for transmitting 30 horse-power by electrical agency to a distance of nearly 4,000 feet through a copper wire .276 inch in diameter, (No. 2, new gauge,) at the works of MM. Blosch-Neuhaus, Biel, Switzerland. The Thury dynamo-electric machines are used, and run at 50) revolutions per minute. These machines are multipolar, in the form of a hexagonal prism, the armatures resembling those of the Siemens machines, but differing in the method of coupling the wires.

— At Waterbury, Conn., a new company just organized, expect to have a system in running operation about July 23. The system to be used here is the Thomson-Houston of Boston, one that has been selected after careful examination of the different systems, and is without doubt the most perfect and complete in use anywhere. The plant will be located in a new building, 30x80, erected on the vacant lot near the works of the American Ring Company, where everything is now being put in readiness for the start. The station is equipped with a 100-horse power boiler and two 50-horse power Armington & Sims high-speed engines. The plant has a present capacity of 120 arc lights of 2,000 candle power each. The company expects to have the 40 lights which it intends to start with, so as to soon supply the customers who are now awaiting patiently the completion of the apparatus.

— The invention of the dynamo-electric machine has been largely discussed for some time. Some electricians, says the *Bulletin de la Compagnie Internationale des Telephones*, jealous of the incontestable success of the Gramme machine, have endeavored to find predecessors and have striven to diminish its merits. They have opposed to it the Pacinotti ring, the superiority of which Professor Sylvanus Thompson has lately claimed to have established. We have not to refute such opinions; the following dispatch, addressed from Turin this week to M. Gramme, decides the question absolutely: "Gramme, 15, Rue Drouot, Paris —The Judges and organizers of the Turin Electrical Exhibition, assembled in banquet, salute Monsieur Gramme, the first inventor of industrial dynamo machines." Even the compatriots of Pacinotti recognize in M. Gramme the inventor of the industrial machines; this is, in our opinion, the best proof that the latter could claim, and we join heartily in the homage of the electricians of Turin.

ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENT OF THE UNITED STATES WERE GRANTED IN THE WEEK ENDING JULY 8, 1884.

301,499 Conducting cord for telephones; Milo G. Kellogg, Hyde Park, Ill., assignor to Western Electric Company, Chicago, Ill.

301,547 Apparatus for forming sections of underground electrical conduits of plastic material; Benezette Williams, Chicago, Ill.

301,550 Electric arc lamp; Clinton M. Ball, Troy, N. Y.

301,551 Electric arc lamp; Clinton M. Ball, Troy, N. Y.

301,560 Electro-magnetic clock; Augustus S. Crane, Newark, N. J.

301,601 Means for operating secondary clocks; Charles Almon Jackson, Lawrence, Mass.

301,602 Electric motor; Charles Almon Jackson, Lawrence, Mass.

301,603 Telephone system; William A. Jackson and William R. Cole, Detroit, Mich., assignors to the Western Electric Company, Chicago, Ill.

301,604 Telephone system; William A. Jackson and William R. Cole, Detroit, Mich., assignors to the Western Electric Company, Chicago, Ill.

301,645 Combined fire-alarm and time detector; James A. Tilden, Hyde Park, Mass.

301,655 Binding post for electric wires; John Young, Chicago, Ill., assignor to the Western Electric Company, same place.

301,749 Telephone; Nathaniel Parks, Deansville, and Frank J. Callanen, Utica, N. Y.

301,763 Electric stock indicator; Albert Buttles Smith, New York, N. Y., assignor of three-fourths to John W. Dexter, Edward Dexter, and Erastus G. Knight, all of same place.

301,805 Transmitting device for primary electric clocks and means for actuating secondary clocks thereby; Charles L. Clarke, New York, assignor to Telemeter Company, same place.

301,837 Railroad electric signal apparatus; Chas. A. Scott, Boston, Mass., assignor to the Union Switch and Signal Company, Pittsburgh, Pa.

A printed copy of the specification and drawing of any patent to the annexed list, also of any patent issued since 1865, will be furnished by any of the patent solicitors whose advertisements appear in this journal. In ordering please state the number and date of the patent desired.

If an invention has not been patented in the United States for more than one year, it may still be patented in Canada. Cost for Canadian patent, $40.00. Various other Foreign patents may also be obtained.

Average Market Quotations of Battery Supplies for the Week Ending July 19th, 1884.

Leclanche Disque Cell, complete	$1.25
" Prism " "	$1.67
" Prisms, per pair	$1.00
" Carbon Mounted	30c.
" Jar Cover	12c
" Sal Ammoniac, in bag	8c.
" Porous Cell	$1.10
" Glass Jar	18c.
" Amalgamated Zinc	10c.
" Rubber Bands, per pair	6c.
Chlorine Battery, per cell	$1.25
Law Battery, per cell	$1.35
" Jar and its Rubber Ring	25c.
" Cover, with small Carbon sealed in	35c.
" Large Carbons, each	20c.
" Carbon Connector	12c.
" Zinc Connector	8c.
" Rubber Bolt	12c.
" Zinc and its Rubber Ring	12c.
Bergman & Haid, per cell	$1.20
Crow foot, 6x8, per cell	75c.
Callaud Zincs	30c.
" Coppers	15c.
" Jars	25c.
Sal Ammoniac, per lb	15c.
Blue vitriol, per lb	10c.
" " bbl., lots, per lb	5½c.
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Hydrometer	50c.

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A. G. DAY, Kerite Insulated Telegraph and Telephone Wire and Cables, Anti-induction Kerite Telephone Cables, CLARKE B. HOTCHKISS, New York. Send for circular and prices.

ALFRED F. MOORE, Philadelphia, Pa. Telegraph, Telephone, Electric Light, Office, Line and Annunciator Wire.

AMERICAN BELL TELEPHONE CO., Boston, Mass. Electric Speaking Telephones for Exchange Systems, Private Lines, and Speaking-tube Lines.

AMERICAN ELECTRICAL WORKS, Providence, R. I. Patent Finished Insulated Electric Wires, Telephone and Electric Cordage. Electric Light Wire, Magnet Wire, Patent Rubber covered Wire, Aerial and Underground Cables, &c., &c. Send for prices.

AMERICAN INSULATOR COMPANY, New York. Insulators of all sizes.

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AUSTIN GALLAGHER, New York, Keith Electric Light System complete for Arc Lighting. Stock for sale.

BAXTER ELECTRIC LIGHT COMPANY, New York. The Baxter Lamp.

A. M. YOUNG, Waterbury, Conn.. Leclanche Zincs. Old style of rod with new connection.

B. W. PAYNE & SONS, Corning, N. Y. The Payne Single and Double Valve Automatic Engine. Send for catalogue.

BERGMAN & Co., New York. The Bergman and Haid Battery for Telephone and Telegraph purposes. Send for circular.

BOULTON CARBON CO., Cleveland, Ohio. Carbons for Electric Light purposes. Send for quotations.

BROWNLEE & Co., Detroit, Mich. Telegraph and Telephone Poles.

BRUSH ELECTRIC CO., Cleveland, Ohio. Arc Lights and Brush Storage Batteries.

BUFFALO ELECTRIC WORKS, Buffalo, N. Y. Carbon Points and Plates.

BUTLER HARD RUBBER COMPANY, New York. Rubber Insulators and Electrical Supplies of every description.

C. H. MOORE & Co., Washington, D. C. Solicitors of American and Foreign Patents.

C. P. WHITNEY, New York. General Eastern Agent of the Detroit Iron Tower Company. Towers and Arches, for Park and Street Lighting.

CHARLES WILLIAMS, JR., Boston, Mass. Call Bells, Electric Bells, District Bells, Switch Boards, Annunciators, &c., &c. Write for quotations.

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CONNOLLY BROTHERS, New York, Patent Attorneys and Solicitors.

CORNELL UNIVERSITY, Ithaca, N. Y. Electrical Engineering.

DETROIT ELECTRIC COMPANY, Detroit, Mich., white oak Pins and Brackets.

D. VAN NOSTRAND, New York. Scientific Books. Send for circular.

F. E. KINSMAN & Co., New York. Imported and Experimental Apparatus, Geisler Tubes, Motors, Coils, Lanterns, etc.

HARVEY, STAFFORD & Co., Acton, Ont., Canada Telegraph and Telephone Poles.

H. M. RAYNOR, New York. Platinum for all purposes.

HOLMES, BOOTH & HAYDENS, New York. Fireproof Electric Light Wire, Patent "KK" Insulated Copper and Iron Wire for Telephone and Telegraph use. Send for catalogue and prices.

I. W. COLBURN & Co., Fitchburg, Mass. Dynamo Electric Machines.

J. O. SHIRAS, Cincinnati, O. Telephone Stocks bought and sold.

JARVIS ENGINEERING COMPANY, Boston, Mass. Boilers set with the Jarvis Patent Furnace.

LECLANCHE BATTERY COMPANY, New York. The Great Telephone Battery. Write for description and prices.

J. H. BUNNELL & Co., New York. The Morse Learner's Instrument, Telegraph Instruments of all kinds, Telephone and Telegraph Supplies. Illustrated Works on Electrical Measurement, and the Galvanometer and its uses. Send for catalogue.

LAW TELEGRAPH CO., New York. The Law Battery for Telephone and Telegraph purposes.

MITCHELL, VANCE & Co., New York, manufacturers of Electroliers and Combination Fixtures, for both gas and electric light.

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At a meeting of the Executive Committee of the American Electric and Illuminating Co. held to-day, it was resolved that all orders and applications which have been filed with the Treasurer for the Preferred Treasury Stock of this Company at par (as advertised above, must be completed by the payment of the first installment on or before Thursday, July 10, 1884, and that no subscriptions at par be received after that date.

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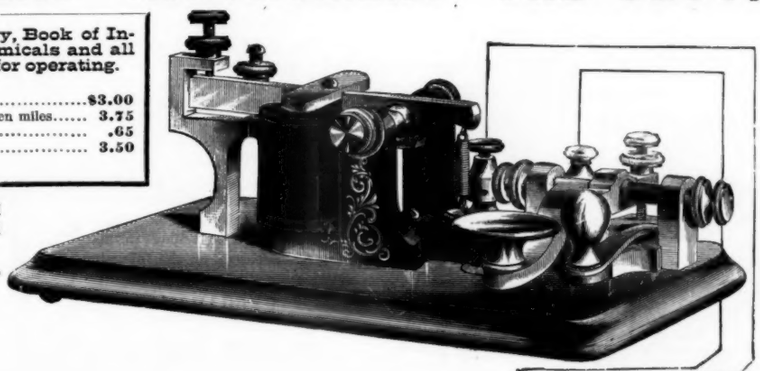

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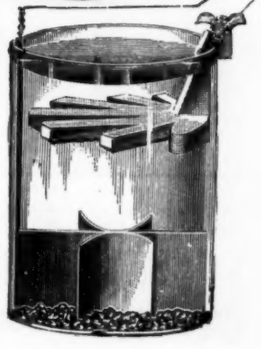

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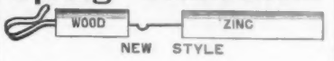

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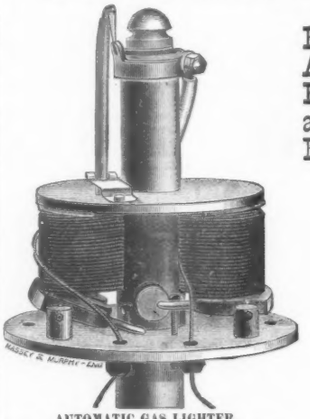

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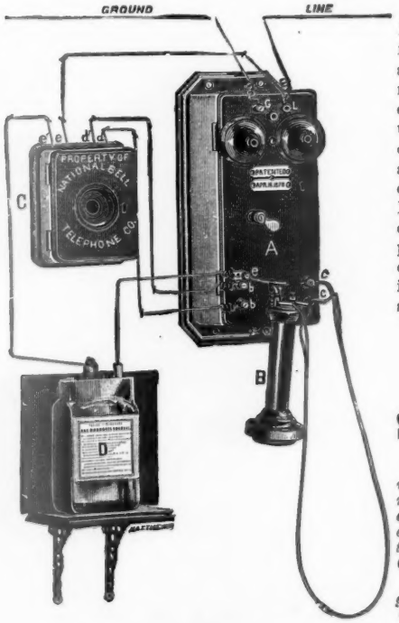

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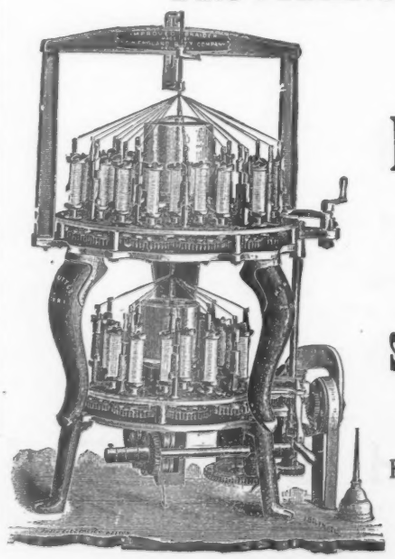

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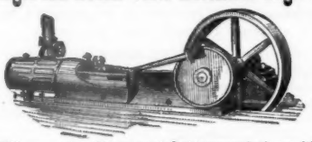

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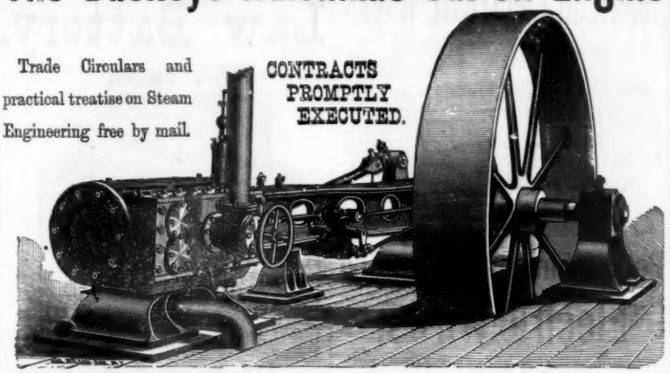

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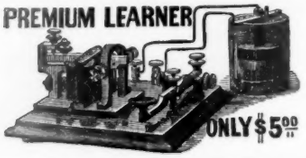

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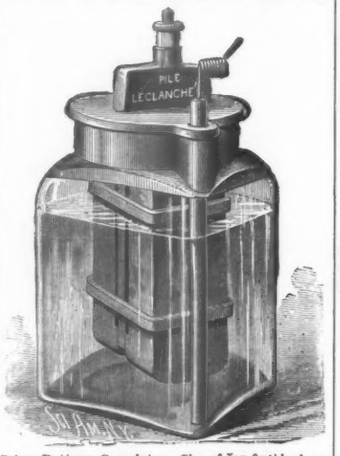

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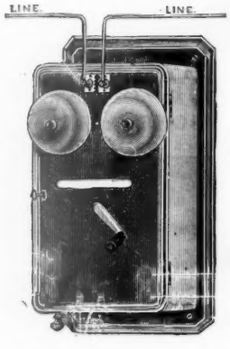

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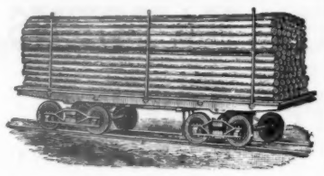

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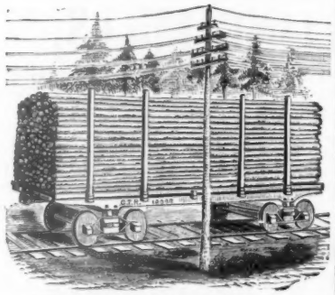

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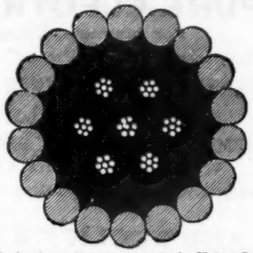

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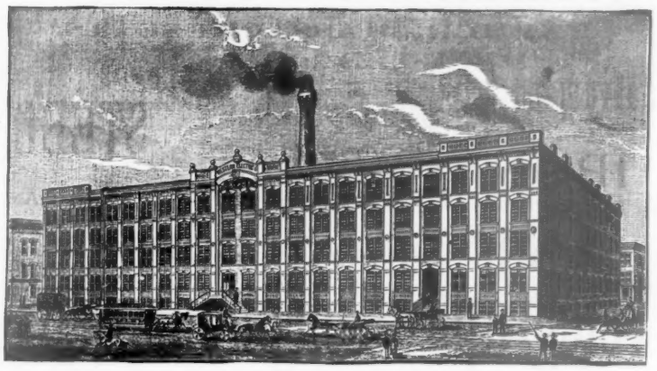

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